Foreword

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

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

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

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

Jack P. Kanalz
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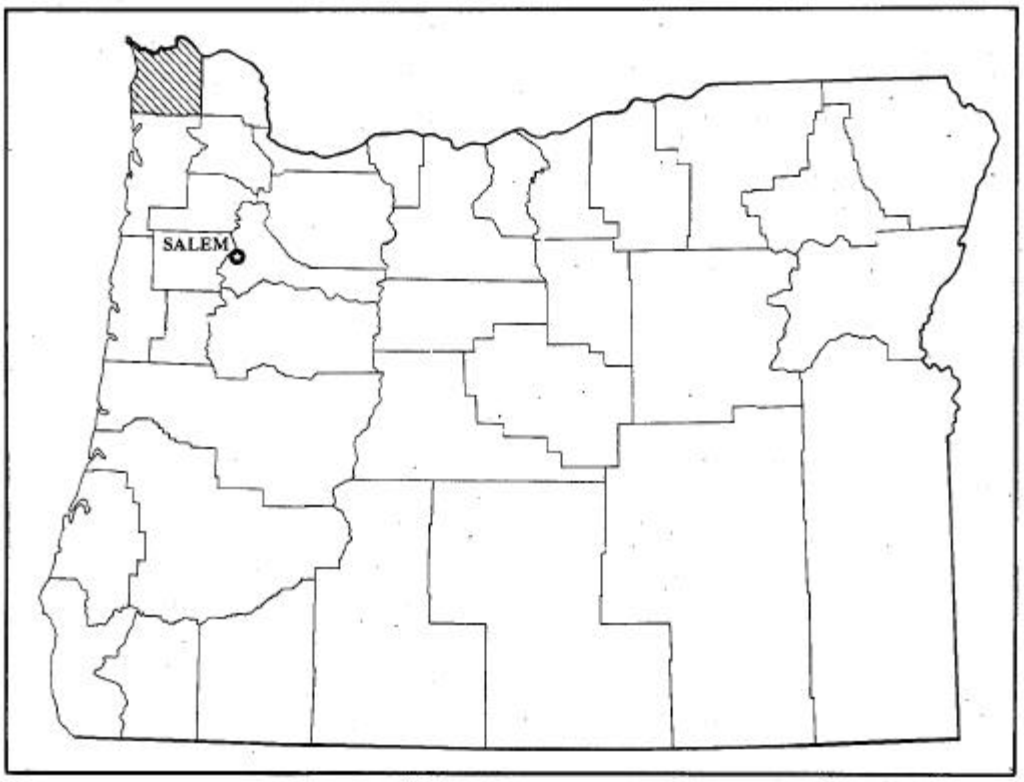

Location of Clatsop County in Oregon.

Soil Survey of
Clatsop County, Oregon

By Philip R. Smith and John A. Shipman,
Soil Conservation Service

Fieldwork by Philip R. Smith, John A. Shipman, Roger Pfenninger, and Richard T. Smythe, Soil Conservation Service

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

CLATSOP COUNTY has a total area of 558,867 acres, including 514,944 acres of land and 43,923 acres of water. The county is bounded on the north by the Columbia River. The west side of the county is a coastline of beaches and jutting headlands. The south side borders Tillamook County and is characterized by broad river bottoms and rugged mountain peaks. The east side borders Columbia County; basaltic mountains, areas of dissected marine sediment, and river valleys are along this boundary.

Clatsop County has a total population of 32,700, most of whom live in the towns of Arch Cape, Astoria, Cannon Beach, Gearhart, Hammond, Seaside, Tolovana Park, Warrenton, and Westport and in the rural communities of Brownsmead, Elsie, Hamlet, Knappa, Jewell, and Svensen. Astoria is a major shipping port. Timber products are the main commodities shipped at present.

The Burlington Northern Railroad runs between Astoria and Portland. U.S. Highway 30 begins at Astoria and crosses the northern part of the county. U.S. Highway 101 runs north and south along the coast. Within recent years U.S. Highway 26, or Sunset Highway, has been completed. This is a major route for transportation between Portland and the coast. Oregon Highway 202 connects Astoria with Jewell and communities in Columbia County.

Air transportation is expanding in Clatsop County. Astoria airport provides facilities for charter and private aircraft. The U.S. Coast Guard has an airbase at the Astoria airport for helicopters and twin engine jets. Seaside and Oregon National Guard Camp Rilea have airstrips to accommodate small aircraft.

There are two hospitals in Clatsop County-Columbia Memorial Hospital in Astoria and Seaside General Hospital.

Timber-related industries, fishing, agriculture, recreation, education, and services to the inhabitants provide most of the jobs in the survey area. Tourism has become a major source of income.

An older survey, "Astoria Area, Oregon," was published in 1949. This earlier survey covers a part of the present survey. The present survey, however, updates the earlier survey and provides additional information and larger maps that show the soils in greater detail.

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

General Nature of the Survey Area

This section gives general information about the survey area. It discusses history and development; physiography, relief, and drainage; and climate.

History and Development

Clatsop County was named for the Clatsop Indians, one of the many Chinook tribes living in Oregon. Lewis and Clark wintered at Fort Clatsop during their 1805-06 expedition to the Pacific Coast.

Astoria was established as a fur trading post in 1811 and named after John Jacob Astor. Astoria did not remain a fur trading center for long, as settlers soon became aware of the fishing and timber resources in the area. The first post office west of the Rocky Mountains was established in Astoria in 1847. The first courthouse was completed in 1855; the present courthouse was erected in 1904.

Seaside was founded in the early 1870's by Ben Holladay, pioneer railroad builder, with his construction of the Seaside House, the famous luxury hotel for which the city was named.

Timber, fishing, agriculture, and recreation have been the main sources of income in Clatsop County.

The Columbia River and Youngs Bay support the fishing industry in Astoria, Hammond, and Warrenton. Fish processing plants are in operation in the Hammond area. Commercial and sport fishing are important to the economy of the area.

Forests covered most of the county when it was first settled. Sawmills were established along the Columbia River and some of its tributaries. Bradwood, Clifton, and Westport once had thriving sawmills. Today, large mills are at Astoria, Warrenton, and Wauna. The commercial forest lands are managed mainly by the Oregon State Department of Forestry and private timber companies. Also, small areas are owned by private woodland operators.

Agriculture has been limited to production of cole crops, hay, and pasture. Early settlers claimed thousands of acres of land along the Columbia River and tidal basins of tributary streams, and they installed levees and tide gates to protect the land from tide water. Large areas of pastures are now productive because of the levees. Areas used for dairy cattle and other livestock operations have remained quite constant throughout the county. Mink farming was popular until prices dropped. Only a few mink farms are still in production. Cranberries, caneberries, blueberries, holly, and flowers are produced on limited acreages.

Hunting and fishing are popular forms of recreation throughout the survey area. Picnicking, sunbathing, and beachcombing are popular along the beaches of Arch Cape, Cannon Beach, Gearhart, Seaside, and Tolovana Park. Fort Stevens State Park, near Warrenton, is a major campground and tourist attraction on the northern coast. Fort Clatsop, near the Lewis and Clark River, is a popular tourist attraction associated with the Lewis and Clark Expedition. The city of Astoria and the surrounding areas have several points of interest, including the Astor Column, at the summit of Coxcomb Hill; the Flavel House, which is a museum; and the Columbia River Maritime Museum, along the Columbia River.

The sand dune area extending from Seaside to the Columbia River has influenced the history and development of the county. During the 1930's the shifting sands of the dunes became a threat to residents along the coast. The Civilian Conservation Corps erected barriers and planted grass, shrubs, and shore pine in the dunal area. The area became stabilized, and today it is recognized as one of the most successful stabilization projects in the West. Luxury homes are being built on the stabilized dunes.

During the Spanish-American War, Fort Stevens was established at the mouth of the Columbia River. It was manned by the military until after World War II.

Physiography, Relief, and Drainage

The topography of Clatsop County is dominated by steep mountains, dissected terraces, and broad river valleys.

Much of Clatsop County consists of old marine sediment that has been uplifted and pierced by intrusive basalt and covered by basalt flows. Most of the higher mountain peaks are basaltic material, including breccia basalt, tuff breccia, and basaltic flow rock. The uplifting action has caused landslides and mixing of the basalt and sedimentary material. Many areas in the county are unstable when disturbed.

Abrupt mountain peaks characterize areas of the county. Saddle Mountain, in the central part of the county; Mount Nicolai, in the northeastern corner; and Onion Peak, in the southwestern corner are all more than 3,000 feet in elevation. Other significant peaks in the county are Angora Peak, Davis Point, Elk Mountain, Humbug Mountain, Kidders Butte, Sugarloaf, and Wickiup Mountain.

Tillamook Head extends into the Pacific Ocean just south of Seaside. With an elevation of more than 1,100 feet, it influences the climatic conditions of the surrounding area. In summer fog often remains in the Seaside area for days, while a few miles away the sun is shining. During stormy periods in fall, winter, and spring, Tillamook Head influences the pattern and intensity of storms.

The southern part of the county is dominantly basaltic. The southeastern corner is dissected by many small streams such as Rock Creek and Quartz Creek. The southwestern corner has a series of high peaks. The elevation drops sharply to the Pacific Ocean on the west and to the North Fork Nehalem River on the east.

The Nehalem River, where it enters Clatsop County from the east, is a very slow, meandering stream in a wide valley. South of U.S. Highway 26 at Jewell junction, it cut through basalt to form a narrow canyon with vertical side walls. Rapids and falls are common. The river changes in elevation from 420 feet at U.S. Highway 26 to 150 feet at the Tillamook County line.

The Necanicum River is the major drainageway in the southwestern part of the county. Its headwaters are in the Humbug Mountain area. The South Fork Necanicum River has its headwaters in the Sugarloaf and Kidders Butte area. Other creeks drain Davis Point, Twin Peaks, and other mountainous areas and add to the flow of the Necanicum River. The river flows through the center of Seaside and forms an estuary bay where it has its confluence with Newanna and Neacoxie Creeks and discharges into the Pacific Ocean.

Youngs Bay is a part of the Columbia River estuary. Four major streams flow into Youngs Bay. The Lewis and Clark River drains the southern and western sides of Saddle Mountain. It also drains the northern side of Humbug Mountain, Davis Point, and the surrounding foothills. Youngs River drains the north slopes of Saddle Mountain and the Green Mountain area. The Klatskanine and Walluski Rivers drain the south slopes of Wickiup Mountain, Elk Mountain, and extensive ridges of uplifted sediment.

Bear Creek, Big Creek, Gnat Creek, John Day River, and Marys Creek are the major drainageways that flow into the Columbia River east of Astoria. Several other small creeks dissect the marine sediment and uplifted basalt of Wickiup Mountain.

Climate

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

The climate of Clatsop County is greatly tempered by wind 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 higher elevations. In summer, rainfall is extremely light, and often several weeks pass without precipitation. Rains are frequent during the rest of the year, especially late in fall and in winter.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Astoria in the period 1953-79. Table 2 shows probable dates of the last freeze in spring and the first freeze in fall. Table 3 provides data on length of the growing season.

In winter, the average temperature is 43 degrees F and the average daily minimum temperature is 37 degrees. The lowest temperature on record, which occurred at Astoria on December 8, 1972, is 6 degrees. In summer, the average temperature is 59 degrees and the average daily maximum temperature is 67 degrees. The highest recorded temperature, which occurred on July 11, 1961, is 100 degrees.

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

Of the total annual precipitation, 16 inches, or 25 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 14 inches. The heaviest 1-day rainfall during the period of record was 3.59 inches at Astoria on December 26, 1974. Thunderstorms occur on about 7 days each year, and most occur in summer.

The average seasonal snowfall is 7 inches. The greatest snow depth at any one time during the period of record was 18 inches. On an average of 2 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 90 percent. The sun shines 65 percent of the time in summer and 25 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 10 miles per hour, in winter.

In most winters, one or two storms over the whole area bring strong and sometimes damaging winds, and in some years the accompanying heavy rains cause serious flooding. Every few years, either in winter or summer, a large invasion of a continental airmass 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

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

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the

area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

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

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

While the soil survey was in progress, samples of some of the soils in the area were collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses and under different levels of management. Some interpretations were modified to fit local conditions, and some new interpretations were developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

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

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

General Soil Map Units

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

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

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

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

Map Unit Descriptions

Soils on flood plains, terraces, and dunes in the fog belt

Three map units are on these landscape positions. They make up about 13 percent of the survey area.

1. Coquille-Clatsop

Very *deep, very poorly drained silt loam and muck; on tide influenced flood plains*

This unit consists of soils in tidal areas along the Columbia River and major streams draining into the river. The native vegetation is rushes, marsh grasses, sedges, and willows. About 48 percent of this unit is protected from flooding and tidal action. During winter storms, tides may exceed 10 feet. Slope is 0 to 1 percent. Elevation is 5 to 10 feet. The mean annual precipitation is 70 to 100 inches, the mean annual air temperature is 48 to 51 degrees F, and the frost-free period is 180 to 220 days.

This map unit makes up about 3 percent of the survey area. Coquille and Clatsop soils are dominant in the unit. Of minor extent are Bergsvik, Brallier, and Coquille Variant soils, Tropofluvents, and Tropopsamments.

Coquille soils are very deep and very poorly drained. In some areas drainage has been altered by dikes, open ditches, and tile drains. The upper layer is very dark gray silt loam. Below this to a depth of 60 inches or more is dark grayish brown and dark gray silt loam.

Clatsop soils are very deep and very poorly drained. In some areas drainage has been altered by dikes, open ditches, and tile drains. The upper layer is very dark grayish brown muck. The next layer is very dark grayish brown silt loam. Below this to a depth of 60 inches or more is dark gray and very dark gray silt loam.

Areas of this unit that are protected and drained are used for hay and pasture. Areas that are not protected are used for wetland wildlife habitat.

The main limitations of these soils in this unit are wetness and the hazard of flooding. Drainage is needed for maximum production of pasture and hay. Flooding restricts grazing in winter. High humidity, fog, and occasional rainfall prevent the curing of high-quality hay.

2. Grindbrook-Walluski-Hebo

Deep and very deep, moderately well drained and poorly drained silt loam and silty clay loam; on terraces

This unit consists of soils that formed in alluvium. The native vegetation is conifers, hardwoods, shrubs, grasses, and rushes. Slopes are 0 to 30 percent. Elevation is 10 to 500 feet. The mean annual precipitation is 70 to 100 inches, the mean annual air temperature is 48 to 52 degrees F, and the frost-free period is 180 to 245 days.

This map unit makes up about 7 percent of the survey area. Grindbrook, Walluski, and Hebo soils are dominant in the unit. Of minor extent are Brenner, Chitwood, Croquib, Knappa, Knappa Variant, Mues, Nehalem, and Nestucca soils; Humitropepts, some of which are steep; Tropaquepts; and Tropofluvents.

Grindbrook soils are deep and very deep and moderately well drained. Slopes are 0 to 30 percent. The upper layer is black silt loam over very dark brown and dark brown silt loam. Below this is brown silty clay loam over gray silty clay loam.

Walluski soils are very deep and moderately well drained. Slopes are 0 to 20 percent. The upper layer is very dark grayish brown silt loam. Below this is dark yellowish brown and yellowish brown silty clay loam over light brownish gray, mottled silty clay loam.

Hebo soils are very deep and poorly drained. Slopes are 0 to 3 percent. The upper layer is black silty clay loam and silty clay. Below this are dark gray and gray, mottled clay and silty clay over light brownish gray, mottled silty clay loam.

This unit is used for hay, pasture, orchards, gardens, homesites, and recreation. The higher terraces are well suited to use as woodland.

The main limitations of the soils in this unit are susceptibility of the soils to compaction and slow permeability. Grazing during the wet periods in winter and spring compacts the soils. The slow permeability in some of the soils restricts use as septic tank absorption fields. High humidity, fog, and occasional rainfall prevent the curing of high-quality hay and the maturing of some vegetables and fruits.

3. Waldport-Gearhart-Brallier

Very deep, excessively drained, somewhat excessively drained, and very poorly drained fine sand, fine sandy loam, and mucky peat; on dunes and in swales

This unit consists of soils on dunes and in interdunal swales. The soils formed in sand and organic material. The native vegetation is conifers, hardwoods, shrubs, forbs, and sedges. American and European beachgrasses and shore pine have been planted in many of the dune areas. Slopes are 0 to 30 percent. Elevation is 5 to 70 feet. The mean annual precipitation is 70 to 100 inches, the mean annual air temperature is 48 to 52 degrees F, and the frost-free period is 180 to 265 days.

This map unit makes up about 3 percent of the survey area. Waldport, Gearhart, and Brallier soils are dominant in the unit. Of minor extent are Bergsvik, Heceta, and Warrenton soils, Beaches, Dune land, and Tropopsamments.

Waldport soils are very deep and excessively drained. They are on dunes. The upper layer is very dark brown and dark brown fine sand. Below this is pale brown and light brownish gray sand.

Gearhart soils are very deep and somewhat excessively drained. They are on dunes. The upper layer is black fine sandy loam and dark brown loamy fine sand. Below this are dark gray and gray fine sand and sand.

Brallier soils are very deep and very poorly drained. They are in swales. The upper layer is very dark grayish brown mucky peat underlain by dark brown mucky peat.

This unit is used for pasture, homesites, gardens, cranberries, commercial flowers, and recreation.

The main limitations of the soils in this unit are very low available water capacity, the hazard of wind erosion, wetness, and subsidence. Unless the dune soils are irrigated, growth of many crops is limited. The risk of wind erosion is high when the soils are disturbed by cultivation or construction. Wetness and subsidence are severe problems on the Brallier soils. Drainage outlets are difficult to maintain.

Soils on mountains in the fog belt

Two map units are on these landscape positions. They make up about 43 percent of the survey area.

4. Skipanon-Templeton-Svensen

Deep and very deep, well drained gravelly silt loam, silt loam, and loam; on mountains

This map unit consists of soils on mountains of sedimentary bedrock. These soils formed in colluvium. The native vegetation is conifers, hardwoods, shrubs, and forbs. Slopes are 3 to 90 percent. Elevation is 20 to 1,600 feet. The mean annual precipitation is 70 to 100 inches, the mean annual air temperature is 45 to 52 degrees F, and the frost-free period is 100 to 245 days.

This unit makes up about 28 percent of the survey area. Skipanon, Templeton, and Svensen soils are dominant in the unit. Of minor extent are Ecola and Millacoma soils.

Skipanon soils are deep and well drained. The upper layer is dark brown gravelly silt loam over brown cobbly silt loam influenced by basalt colluvium. Below this is light yellowish brown and yellowish brown silty clay loam over weathered siltstone.

Templeton soils are deep and well drained. The upper layer is very dark grayish brown and dark brown silt loam. Below this is dark yellowish brown and yellowish brown silty clay loam over weathered siltstone.

Svensen soils are very deep and well drained. The upper layer is very dark brown and dark brown loam. Below this is brown loam over variegated, strong brown and light brownish gray fine sandy loam.

This unit is used as woodland, watershed, recreation, and homesites. The dominant native woodland species are Sitka spruce and western hemlock. Many areas have been planted to Douglas-fir.

The main limitations of the soils in this unit are slope, the hazard of water erosion, and susceptibility to slumping. Slope limits the kinds of equipment that can be used for logging. Exposed areas are subject to erosion during heavy rainstorms. Susceptibility to slumping is a hazard on the side slopes, and the risk is increased if logging roads are built across the steeper slopes. Slope limits the soils in this unit for homesite and recreational development..

5. Klootchie-Necanicum-Ascar

Deep and moderately deep, well drained silt loam, gravelly loam, and extremely gravelly loam; on

mountains

This map unit consists of soils on basalt mountains. These soils formed in colluvium. The native vegetation is conifers, hardwoods, shrubs, and forbs. Slopes are 3 to 90 percent. Elevation is 100 to 1,600 feet. The mean annual precipitation is 70 to 100 inches, the mean annual air temperature is 45 to 51 degrees F, and the frost-free period is 100 to 210 days.

This map unit makes up 15 percent of the survey area. Klootchie, Necanicum, and Ascar soils are dominant in the unit. Of minor extent are Rock outcrop and Skipanon soils.

Klootchie soils are deep and well drained. The upper layer is dark reddish brown silt loam. Below this are reddish brown silt loam and gravelly loam over partially weathered basalt.

Necanicum soils are deep and well drained. The upper layer is dark reddish brown gravelly loam and very gravelly, loam. Below this are dark brown and dark yellowish brown very gravelly loam and yellowish brown extremely cobbly loam over fractured basalt.

Ascar soils are moderately deep and well drained. They are dark reddish brown. extremely gravelly loam over basalt breccia.

This unit is used as woodland, watershed, and recreation. The dominant native woodland species are western hemlock and Sitka spruce. Many areas have been planted to Douglas-fir.

The main limitations of the soils in this unit are slope, the hazard of water erosion, susceptibility to slumping, and depth to bedrock. Slope limits use of the unit for homesite and recreational development. The risk of water erosion is high if the areas of woodland are harvested and the slash is burned. The steeper areas are susceptible to slumping, and the risk is increased when roads are constructed across the slope. Depth to bedrock limits rooting depth in some areas.

Warm soils on flood plains and terraces

Two map units are on these landscape positions. They make up about 3 percent of the survey area.

6. Locoda-Wauna

Deep and very deep, poorly drained and very poorly drained silt loam; on tide influenced flood plains

This map unit consists of soils on tide influenced flood plains along the Columbia River. These soils formed in alluvium. The native vegetation is cottonwood trees, willows, rushes, sedges, tules, and marsh grasses. Slopes are 0 to 3 percent. Elevation is 5 to 15 feet. The mean annual precipitation is 60 to 80 inches, the mean annual air temperature is 49 to 52 degrees F, and the frost-free period is 165 to 210 days.

This unit makes up about 1 percent of the survey area. Lococa and Wauna soils are dominant in the unit. Of minor extent are Udipsamments, Udifluvents, and Hapludalfs.

Locoda soils are very deep and very poorly drained. The upper layer is very dark grayish brown and grayish brown silt loam. Below this is gray silty clay loam over gray silt loam.

Wauha soils are deep and poorly drained. The upper layer is very dark grayish brown silt loam. Below this is dark grayish brown silt loam over grayish brown and gray silt loam.

About 45 percent of this unit is protected from flooding and high tides by levees and tide gates. These areas are used for pasture, hay, and truck crops. The unprotected areas are used for pasture and wetland wildlife habitat.

The main limitations of the soils in this unit are wetness and the hazard of flooding. Locoda soils are inundated most of the time in winter and spring because of a high water table. The unprotected areas are frequently flooded, and some areas are flooded daily by high tides.

7. Eilertsen-McNulty-Kirkendall

Deep and very deep, well drained silt loam; on terraces and flood plains

This map unit consists of soils on flood plains and terraces of inland waterways. These soils formed in alluvium. The native vegetation consists of conifers, hardwoods, shrubs, grasses, and forbs. Slopes are 0 to 3 percent. Elevation is 250 to 500 feet. The mean annual precipitation is 60 to 80 inches, the mean annual air temperature is 48 to 51 degrees *F,* and the frost-free period is 145 to 210 days.

This map unit makes up about 2 percent of the survey area. Eilertsen, McNulty, and Kirkendall soils are dominant in the unit. Of minor extent are Elsie, Natal, Northrup, and Treharne soils, Udifluvents, and Hapludalfs.

Eilertsen soils are very deep and well drained. They are on stream terraces. The upper layer is very dark brown silt loam. Below this are dark yellowish brown silty clay loam over dark yellowish brown silt loam.

McNulty soils are deep and well drained. They are on flood plains. The upper layer is dark brown silt loam. Below this is dark yellowish brown and dark brown loam and fine sandy loam over dark brown sandy loam.

Kirkendall soils are very deep and well drained. They are on flood plains. The upper layer is very dark grayish brown silt loam. Below this is dark brown and dark yellowish brown silt loam over yellowish brown loam.

This unit is used for hay, pasture, orchards, gardens, homesites, and recreation. The areas on the higher terraces are well suited to use as woodland.

The main limitations of the soils in this unit are flooding and streambank erosion. Flooding is frequent on the McNulty soils and occasional on the Kirkendall soils.

Streambank erosion is a hazard in the areas of pasture and hay adjacent to the streams.

Warm soils on mountains

Three map units are on these landscape positions. They make up about 29 percent of the survey area.

8. Rinearson

Deep, well drained silt loam; on mountains.

This map unit consists of soils on mountains of marine sedimentary rock. These soils formed in colluvium. The native vegetation is conifers, hardwoods, shrubs, and forbs. Slopes are 3 to 90 percent. Elevation is 500 to 1,600 feet. The mean annual precipitation is 60 to 90 inches, the mean annual air temperature is 45 to 49 degrees F, and the frost-free period is 100 to 210 days.

This map unit makes up about 15 percent of the survey area. Rinearson soils are dominant in the unit. Of minor extent the Mayger soils.

Rinearson soils are well drained. The upper layer is very dark brown silt loam. Below this is dark yellowish brown, dark brown, and yellowish brown silty clay loam over weathered siltstone.

This unit used as woodland, watershed, recreation, and wildlife habitat. Douglas-fir and western hemlock are the dominant woodland species.

The main limitations of the soils in this unit are slope, the hazard of water erosion, and susceptibility of the upper layer to compaction. The steepness of slope limits use of logging equipment and use of the unit as homesites. The risk of water erosion is severe in areas of woodland that have been harvested and slashburned. Use of equipment and trampling by animals can compact the upper layer during the wet season.

9. Hemcross-Klistan-Harslow

Very deep and moderately deep, well drained silt loam and gravelly loam; on mountains

This unit consists of soils on basalt mountains. These soils formed in colluvium. The native vegetation is conifers, hardwoods, shrubs, and forbs. Slopes are 3 to 90 percent. Elevation is 200 to 1,600 feet. The mean annual precipitation is 60 to 90 inches, the mean annual air temperature is 45 to 50 degrees F, and the frost-free period is 100 to 210 days.

This unit makes up about 7 percent of the survey area. Hemcross, Klistan, and Harslow soils are dominant in the unit. Of minor extent are Kilchis soils and Rock outcrop.

Hemcross soils are very deep and well drained. The upper layer is dark brown silt loam. Below this is brown and dark yellowish brown silt loam over dark yellowish brown very gravelly loam.

Klistan soils are very deep and well drained. The upper layer is dark brown gravelly loam and very gravelly loam. Below this is dark yellowish brown very gravelly loam.

Harslow soils are moderately deep and well drained. The upper layer is dark brown very gravelly loam. Below this are brown very cobbly loam and extremely gravelly loam over basalt.

This unit is used as woodland, watershed, and recreation. Douglas-fir and western hemlock are the dominant woodland species.

The main limitations of the soils in this unit are slope, the hazard of water erosion, and soil depth in some areas. The steepness of slope severely limits use of equipment and use of the unit as homesites and recreation. The risk of water erosion is severe in the areas of woodland that have been harvested and slashburned. Depth to bedrock in the Harslow soils limits rooting depth and the available water capacity of the soils.

10. Alstony-Scaponia-Braun

Deep and moderately deep, well drained soils; on mountains

This map unit consists of soils on mountains of basalt and marine sedimentary rock. These soils formed in colluvium. The native vegetation is conifers, hardwoods, shrubs, and forbs. Slopes are 3 to 90 percent. Elevation is 200 to 1,600 feet. The mean annual precipitation is 60 to 80 inches, the mean annual air temperature is 45 to 51 degrees F, and the frost-free period is 100 to 210 days.

This unit makes up about 7 percent of the survey area. Alstony, Scaponia, and Braun soils are dominant in the unit. Of minor extent are Anunde, Kilchis, and Tolke soils and Rock outcrop.

Alstony soils are deep and well drained. The upper layer is dark reddish brown gravelly loam. Below this are reddish brown very gravelly loam and dark brown extremely cobbly loam over fractured basalt.

Scaponia soils are deep and well drained. The upper layer is dark brown silt loam. Below this is dark yellowish brown and yellowish brown silt loam over fractured siltstone.

Braun soils are moderately deep and well drained. The upper layer is very dark grayish brown silt loam. The next layer is dark yellowish brown silt loam. Below this is brown and strong brown silt loam over fractured siltstone.

This unit is used as woodland, watershed, and recreation. Douglas-fir and western hemlock are the dominant woodland species.

The main limitations are slope and the hazard of water erosion. The steepness of slopes limits the use of logging equipment and use of the unit as homesites and recreation. The risk of water erosion is severe in the areas of woodland that have been harvested and slashburned.

Cold soils on mountains

One map unit is on these landscape positions. It makes up 12 percent of the survey area.

11. Caterl-Laderly-Murtip

Deep and moderately deep, well drained gravelly silt loam, very gravelly loam, and loam; on mountains

This map unit consists of soils on basalt mountains. These soils formed in colluvium. The native vegetation is conifers, hardwoods, shrubs, grasses, and forbs. Slopes are 3 to 90 percent. Elevation is 1,600 to 2,800 feet. The mean annual precipitation is 80 to 100 inches, the mean annual air temperature is 41 to 45 degrees F, and the frost-free period is 60 to 100 days.

This unit makes up about 12 percent of the survey area. Caterl, Laderly, and Murtip soils are dominant in the unit. Of minor extent are McMille, Newanna, and Tolany soils and Rock outcrop.

Caterl soils are deep and well drained. The upper layer is dark brown gravelly silt loam. Below this are brown gravelly loam and extremely gravelly loam over fractured basalt.

Laderly soils are moderately deep and well drained. The upper layer is very dark brown very gravelly loam. Below this are dark brown very gravelly loam and extremely cobbly loam over fractured basalt.

Murtip soils are deep and well drained. The upper layer is very dark brown and dark brown loam. Below this are brown loam, gravelly loam, and very gravelly loam over basalt.

This unit is used as woodland, watershed, wildlife habitat, and recreation. Douglas-fir, western hemlock, and Pacific silver fir are the dominant woodland species.

The main limitations of the soils in this unit are slope, the hazard of water erosion, susceptibility to slumping, and depth to bedrock. The steepness of slope limits the type of equipment that can be used in harvesting timber. The risk of water erosion is severe in the areas of woodland that have been harvested and slashburned. During periods of heavy rainfall, the steeper areas are susceptible to slumping. The restricted depth to bedrock in the Laderly soils limits root growth, especially in the areas associated with Rock outcrop.

Detailed Soil Map Units

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Grindbrook silt loam, 0 to 7 percent slopes, is one of several phases in the Grindbrook series. Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Coquille-Clatsop complex, 0 to 1 percent slopes, is an example.

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

This survey was mapped at two levels of detail. At the most detailed level, map units are narrowly defined. This

means that map unit boundaries were plotted and verified at closely spaced intervals. These units are on flood plains and terraces. At the less detailed level, map units are broadly defined. Boundaries were plotted and verified at wider intervals. These units are in mountainous areas.

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

In the map unit descriptions that follow, a semi-tabular format is used. In this format a boldface heading (for example, Composition) is used to identify the kind of information grouped directly below it. Introducing each item of information under the heading is an italicized term or phrase (for example, *Position on landscape:)* that identifies or describes the information. Many of the boldface headings and introductory terms or phrases are self-explanatory; however, some of them need further explanation. These explanations are provided in the following paragraphs, generally in the order in which they are used in the map unit descriptions.

Composition is given for the components identified in the name of the map unit as well as for the contrasting inclusions.

Inclusions are areas of components (soils or miscellaneous areas) that differ from the components for which the unit is named. Inclusions can be either similar or contrasting. *Similar inclusions* are components that differ from the components for which the unit is named but that for purposes of use and management can be considered to be the same as the named components. Note that in the "Composition" paragraph a single percentage is provided for a named soil and the similar inclusions because their use and management are similar.

Contrasting inclusions are components that differ sufficiently from the components for which the unit is named that they would have different use and management if they were extensive enough to be managed separately. For most uses, contrasting inclusions have limited effect on use and management. Inclusions generally are in small areas, and they could not be mapped separately because of the scale used. Some small areas of strongly contrasting inclusions are identified by a special symbol on the detailed soil maps. A few inclusions may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it Was impractical to make enough observations to identify all the inclusions on the landscape.

Position on landscape refers to the dominant position or positions on which the component is located. In naming landscape positions, an effort has been made to give the specific position of the component rather than a general position that could encompass other components. In some instances, however, the component is distributed over a larger landscape to such a degree that it is more nearly accurate to name the larger landscape positions rather than the local ones.

Native plants are the plants that grow in the climax plant community.

Typical profile is a vertical, two-dimensional section of the soil extending from the surface to a restrictive layer or to a depth of 60 inches or more.

Depth class is an adjective term (for example, moderately deep) for the depth of the soil. Following the term is a numerical range (for example, 20 to 40) that reflects the range in depth in inches of the various areas of the soil.

Permeability is the quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil.

Available water capacity is the capacity of the soil to hold water available for use by most plants. It commonly is expressed as inches of water per inch of soil (see "Glossary").

Hazard of erosion refers to the hazard if protective plant cover is removed. The hazard of erosion is constant and cannot be increased or reduced.

Major uses are the dominant uses at the time the major. part of the fieldwork for this survey was completed.

Major management factors are those factors that affect the use of the soils for the major uses. The soil-related factors are limiting, whereas the climatic factors can be either limiting or nonlimiting. The major management factors may apply to the entire unit or to a given component of the unit.

General management considerations provide additional perspective on the suitability and limitations of the unit for the major uses. They may apply to the entire unit or to a given component of the unit.

Suitable management practices are practices that can be used to overcome the main limitations of the components for the major uses. These practices are among those that were suitable at the time that the major fieldwork for this survey was completed. Some of these practices may be applied throughout the unit or only in some areas of the unit; for example, practices required to overcome the limitation of shallow soil depth may be applicable to only one of the soils in a soil complex.

Map Unit Descriptions

1D-Alstony gravelly loam, 3 to 30 percent slopes.

Composition

Alstony soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Alstony Soil

Position on landscape: Toe slopes
Slope range: 3 to 30 percent
Elevation: 300 to 1,600 feet
Native plants: Douglas-fir, western hemlock, vine maple, salal, cascade Oregon-grape, salmonberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, twigs, and leaves *2* inches thick
Typical profile:
0 to 7 inches - dark reddish brown gravelly loam
7 to 47 inches - reddish brown very gravelly loam
47 to 53 inches - dark brown extremely cobbly loam
53 inches - basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 7 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that have less than 35 percent rock fragments throughout the profile
Soils that have weathered siltstone at a depth of 40 to 60 inches
Soils that are wet

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Gravel and cobbles, susceptibility of the upper layer to compaction, erosion by water, low extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 47 to 50 degrees F
Frost-free period - 100 to 180 days

Woodland

Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 122 (based on 50-year site curve)
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Careless use of wheeled and tracked equipment disturbs the protective layer of duff.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Heavy equipment and ground skidding methods of harvesting timber are likely to compact the soil if it is wet.
Adequately designed road drainage reduces the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Logging roads require suitable surfacing for year-round use.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.
Rock for road construction is available in this unit.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and. landings, installing water bars and culverts, and seeding cuts and fills.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

1E-Alstony gravelly loam, 30 to 60 percent slopes.

Composition

Alstony soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Alstony Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 300 to 1,600 feet
Native plants: Douglas-fir, western hemlock, vine maple, salal, cascade Oregon-grape, salmonberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, twigs, needles, and leaves 2 inches thick
Typical profile:
0 to 7 inches - dark reddish brown gravelly loam
7 to 47 inches - reddish brown very gravelly loam
47 to 53 inches - dark brown extremely cobbly loam
53 inches - fractured basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 7 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have basalt at a depth of less than 40 inches
Soils that have less than 35 percent rock fragments throughout the profile

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, gravel and cobbles, low extractable phosphorus ,
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 47 to 52 degrees F
Frost-free period - 100 to 180 days

Woodland

Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 122 (based on 50--year site curve)
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Adequately designed road drainage reduces the risk of erosion.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Susceptibility of cut and fill areas to erosion is moderate.
Logging roads require suitable surfacing for year round use.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.
Rock for road construction is available in this unit.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

1F-Alstony gravelly loam, 60 to 90 percent slopes.

Composition

Alstony soil and similar inclusions - 75 percent
Contrasting inclusions - 25 percent

Alstony Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 300 to 1,600 feet
Native plants: Douglas-fir, western hemlock, vine maple, salal, cascade Oregon-grape, salmonberry, western swordfern

Organic mat on surface: Moss, needles, twigs, and leaves 2 inches thick
Typical profile:
0 to 7 inches - dark reddish brown gravelly loam
7 to 47 inches - reddish brown very gravelly loam
47 to 53 inches - dark brown extremely cobbly loam
53 inches - fractured basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 7 inches
Potential rooting depth: 40 to 60 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 60 percent
Soils that have basalt at a depth of less than 40 inches
Rock outcroppings

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, gravel and cobbles, low extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 47 to 52 degrees F
Frost-free period - 100 to 180 days

Woodland

Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 122 (based on 50-year site curve)
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60 year-old trees 1.5 inches or larger in diameter at breast height

General management considerations.'
Slope limits the kinds of equipment that can be used in forest management.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Susceptibility of cut and fill areas to erosion is high.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year round use.
Rock for road construction is available in this unit.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by avoiding excessive disturbance of the soil; seeding roads, cutbanks, and landings; and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

2D-Anunde silt loam, 3 to 30 percent slopes.

Composition
Anunde soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Anunde Soil

Position on landscape: Structural benches
Slope range: 3 to 30 percent
Elevation: 200 to 900 feet
Native plants: Douglas-fir, western hemlock, western redcedar, vine maple, cascade Oregon-grape, red huckleberry, western swordfern
Organic mat on surface: Moss, needles, twigs, and leaves 1 inch thick
Typical profile:
0 to 18 inches - dark brown silt loam
18 to 53 inches - brown and dark yellowish brown silt loam
53 to 60 inches - dark yellowish brown silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 11 to 13 inches
Potential rooting depth: 60 inches or more

Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that are wet
Soils that have more than 35 percent rock fragments throughout the profile
Soils that are fine-loamy to coarse-loamy throughout the profile

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Susceptibility of the upper layer to compaction, erosion by water, low extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 48 to 52 degrees F
Frost-free period - 140 to 210 days

Woodland
Mean site index for stated species: Douglas-fir - 182 (based on 100-year site curve); 136 (based on 50-year site curve)
Estimated total production per acre: 112,320 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 193 cubic feet per acre in a stand of 60 year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.,
Careless use of wheeled and tracked equipment, disturbs the protective layer of duff.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Logging roads require suitable surfacing for year-round use.
Adequately designed road drainage reduces the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Reduce the risk of erosion by seeding roads, cutbanks, landings, and cuts and fills.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

3F-Ascar-Rock outcrop complex, 60 to 90 percent slopes.

Composition

Ascar soil and similar inclusions - 45 percent
Rock outcrop and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Ascar Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 400 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salmonberry, salal, western swordfern.
Organic mat on surface: Moss, needles, twigs, and leaves 2 inches thick
Typical profile:
0 to 35 inches - dark reddish brown extremely gravelly loam
35 inches - hard basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 2 to 4 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe (fig. 1)

Rock Outcrop

Kind of rock: Basalt breccia

Included Areas

Soils that have slopes of less than 60 percent or more than 90 percent
Soils that have basalt at a depth of less than 20 inches or more than 40 inches

Figure 1.-Erosion in a rock pit in an area of Ascar-Rock outcrop complex, 60 to 90 percent slopes.

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, rock outcroppings in some areas, depth to bedrock, rooting depth, gravel, available water capacity

Climatic factors (mean annual):

Precipitation - 70 to 100 inches

Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)

Frost-free period - 100 to 210 days

Woodland

Ascar Soil

Mean site index for stated species: western hemlock - 145 (based on 100-year site curve); 103 (based on 50-year site curve)

Estimated total production per acre: 97,510 board feet (International rule, one-fourth-inch kerf) from a fully

Growth at culmination of mean annual increment (CMAI): 228 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.

Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.

Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.

Susceptibility of cut and fill areas to erosion is high.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Logging roads require suitable surfacing for year-round use.

Rock for road construction is available in this unit.

Rock outcrop causes breakage of timber and hinders yarding.

The areas of Rock outcrop in this unit limit yield.

Trees are subject to windthrow because of the limited rooting depth.

Windthrow is a hazard when the soil is saturated and winds are strong.

The limited available water capacity increases seedling mortality.

Reforestation occurs naturally in cutover areas if a seed source is present.

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

Carefully managed reforestation reduces competition from undesirable understory plants.

Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices

Use highlead or other logging that fully or partially. suspends logs because it is less damaging to the soil.

Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Manage regeneration carefully to reduce the competition of less desirable plants and provide shade for seedlings.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

4-Beaches.

Kind of material: Sand and coarse fragments (fig. 2)
Slope range: 0 to 3 percent
Use: Recreation
Effect of waves and wind: Periodic deposition and removal of material
Special features: Some pockets of quicksand in winter and early in spring
Major management factors: Erosion by wind; erosion by water; gravel, cobbles, and stones in some areas; load supporting capacity

5A-Bergsvik mucky peat, 0 to 1 percent slopes.

Composition
Bergsvik soil and similar inclusions - 90 percent
Contrasting inclusions - 10 percent

Bergsvik Soil

Position on landscape: Depressional areas
Slope range: 0 to 1 percent
Elevation: 5 to 20 feet
Native plants: Sitka spruce, western hemlock, western redcedar, willow, salmonberry, skunkcabbage, sedges, rushes, Douglas spirea
Typical profile:
0 to 36 inches - dark reddish brown, black, and very dark grayish brown mucky peat
36 to 60 inches - very dark brown and very dark grayish brown fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Permeability: In the organic layer - moderate; in the sandy layer - moderately rapid
Available water capacity: 16 to 22 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: None
Depth to water table: 12 inches above the surface to 36 inches below the surface throughout the year

Figure 2.-Area of Beaches at low tide.

Frequency of flooding by slow-moving water:
Occasional in December through April

Included Areas

Soils that are sandy throughout the profile
Soils that are organic material throughout the profile
Soils that are sandy in the upper 3 to 12 inches

Major Uses

Wetland wildlife habitat, cropland

Major Management Factors

Soil-related factors: Wetness, inadequate drainage outlets in some areas, load supporting capacity, subsidence
Climatic factors (average annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 220 days

Cropland

General management considerations:
Water tolerant plants can be grown.
Suitable crops for planting are cranberries, blueberries, and cole crops.
Seasonal ponding limits the production and harvesting of crops.
Providing drainage is difficult because most areas have poor outlets and are seasonally flooded.
Drainage should be maintained throughout the growing season.
The low load supporting capacity of the soil limits the harvesting of most crops.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Use open ditches or tile drains to remove water on or near the surface.
Consider the low load supporting capacity of the soil when selecting equipment.

6A-Brallier mucky peat, 0 to 1 percent slopes.

Composition

Brallier soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Brallier Soil

Position on landscape: Depressional areas and flood plains
Slope range: 0 to 1 percent
Elevation: 5 to 20 feet
Native plants: Sitka spruce, red alder, western redcedar, willow, salmonberry, skunkcabbage, sedges, rushes, Douglas spirea
Typical profile:
0 to 60 inches - very dark grayish brown and dark brown mucky peat
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: 18 to 24 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: None
Depth to water table: 12 inches above the surface to 36 inches below the surface throughout the year
Frequency of flooding: Frequent in November through April

Included Areas

Soils that are mineral material between depths of 18 and 51 inches
Soils that are mineral material throughout the profile

Major Uses

Wetland wildlife habitat, cropland

Major Management Factors

Soil-related factors: Wetness, inadequate drainage outlets in some areas, load supporting capacity, flooding, subsidence
Climatic factors (average annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 220 days

Cropland

General management considerations:
Water tolerant plants can be grown.
Suitable crops for planting are cranberries, blueberries, and cole crops.
Seasonal ponding limits the production and harvesting of crops.
Drainage should be maintained throughout the growing season.
The load supporting capacity of the soil limits the harvesting of most crops.
Providing drainage is difficult because most areas have poor outlets.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Use open ditches or tile drains to remove water on or near the surface.

Consider the low load supporting capacity of the soil when selecting equipment.
Provide water control structures to reduce the risk of flooding.

7D-Braun-Scaponia silt loams, 3 to 30 percent slopes.

Composition
Braun soil and similar inclusions - 45 percent
Scaponia soil and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Braun Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, western redcedar, bigleaf maple, red alder, vine maple, cascade Oregon-grape, creambush oceanspray, red huckleberry, salal, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to *3* inches - very dark grayish brown silt loam
3 to 20 inches - dark yellowish brown and brown silt loam
20 to *35* inches - strong brown silt loam
35 inches - weathered siltstone
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 10 inches
Potential rooting depth: 20 to 40 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Scaponia Soil
Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, western redcedar, bigleaf maple, red alder, vine maple, cascade Oregon-grape, creambush oceanspray, red huckleberry, salal, western swordfern
Typical profile:
0 to 7 inches - dark brown silt loam
7 to 43 inches - dark yellowish brown and yellowish brown silt loam
43 inches - weathered siltstone
Depth class: Deep *(40* to *60* inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas
Soils that have basalt at a depth of less than 60 inches
Soils that have slopes of more than 30 percent
Soils that have more than 35 percent hard rock fragments between depths of 10 and 60 inches
Soils that are coarse-loamy between depths of 10 and 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Depth to bedrock in some areas, erosion by water, rooting depth in some areas, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to *80* inches
Soil temperature - 47 to *52* degrees F
Frost-free period - 100 to 180 days

Woodland
Braun Soil
Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 129 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Scaponia Soil
Mean site index for stated species: Douglas-fir - 173 (based on 100-year site curve); 133 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 184 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 105,200 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.

Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.

When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is moderate.
Adequately designed road drainage reduces the risk of erosion.
The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are, needed.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Because roots are restricted by bedrock, trees on the Braun soil commonly are subject to windthrow.
Trees on the Braun soil are subject to windthrow when the soil is excessively wet and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

7F-Braun-Scaponia silt loams, 60 to 90 percent slopes.

Composition

Braun soil and similar inclusions - 45 percent
Scaponia soil and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Braun Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock; western redcedar, red alder, vine maple, cascade Oregon-grape, creambush oceanspray, red huckleberry, salal, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 3 inches - very dark grayish brown silt loam
3 to 20 inches - dark yellowish brown and brown silt loam
20 to 35 inches - strong brown silt loam
35 inches - weathered siltstone
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 10 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Scaponia Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, western redcedar, red alder, vine maple, cascade Oregon--grape, red huckleberry, salal, creambush oceanspray, western swordfern
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 7 inches - dark brown silt loam
7 to 43 inches - dark yellowish brown and yellowish brown silt loam
43 inches - weathered siltstone
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 60 percent
Rock outcroppings
Soils that have more than 35 percent hard rock fragments between depths of 10 and 60 inches
Soils that have basalt at a depth of less than 60 inches
Soils that have weathered siltstone or sandstone at a depth of less than 20 inches

Soils that are coarse-loamy between depths of 10 and 60 inches

Major Uses
Wildlife habitat, woodland

Major Management Factors
Soil-related factors: Slope, erosion by water, depth to bedrock in some areas
Climatic factors (mean annual):
Precipitation - 60 to 80 inches Soil temperature - 47 to 52 degrees F
Frost-free period - 100 to 180 days

Woodland
Braun Soil
Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 129 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Scaponia Soil
Mean site index for stated species: Douglas-fir - 173 (based on 100-year site curve); 128 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 184 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 105,200 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Adequately designed road drainage reduces the risk of erosion.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Spoil from excavations is subject to sheet, rill, and gully erosion and to sloughing.
The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Because roots are restricted by bedrock, trees on the Braun soil commonly are subject to windthrow.
Trees on the Braun soil are subject to windthrow when the soil is excessively wet and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

8A-Brenner silt loam, 0 to 3 percent slopes.

Composition
Brenner soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Brenner Soil

Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 15 to 300 feet
Native plants: Sedges, rushes, skunkcabbage, grasses
Typical profile:
0 to 10 inches - dark brown silt loam
10 to 30 inches - grayish brown, mottled silty clay loam
30 to 60 inches - greenish gray, mottled silty clay loam
and greenish gray silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Permeability: Slow
Available water capacity: 10 to 12 inches

Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: December through April - 6 inches above the surface to 12 inches below the surface
Frequency of flooding: December through April - frequent

Included Areas

Soils that are better drained
Soils that are silt loam or loam throughout the profile

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Flooding, wetness, inadequate drainage outlets in some areas, load supporting capacity, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 245 days

Cropland

General management considerations:
Most climatically adapted crops can be grown if adequate drainage and protection from flooding are provided.
Providing drainage is difficult because most areas have poor outlets and are seasonally flooded.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Seed only the hay and pasture plants that tolerate periodic inundation and seasonal wetness.
Provide water control structures to reduce the risk of flooding.
Use open ditches or tile drains to remove water on or near the surface.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Reduce the risk of erosion by using minimum tillage and seeding disturbed areas to native or tame pasture plants.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

9D-Caterl-Laderly complex, 3 to 30 percent slopes.

Composition
Caterl soil and similar inclusions - 45 percent
Laderly soil and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Caterl Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry, salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 12 inches - dark brown gravelly silt loam
12 to 28 inches - brown gravelly loam
28 to 43 inches - brown extremely gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Laderly Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry, salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Typical profile:
0 to 16 inches - very dark brown and dark brown very gravelly loam

16 to 21 inches - dark brown very gravelly loam
21 to 37 inches - dark brown extremely cobbly loam
37 inches - basalt

Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that have weathered siltstone between depths of 20 and 60 inches
Soils that have basalt at a depth of less than 20 inches
Rock outcroppings
Soils that have less than 35 percent rock fragments throughout the profile
Soils that are wet

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Gravel, cobbles in some areas, depth to bedrock in some areas, rooting depth in some areas, available water capacity in some areas, erosion by water, susceptibility of the upper layer to compaction, low extractable phosphorus
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland

Caterl Soil
Mean site index for stated species: Douglas-fir - 145 (based on 100-year site curve); 115 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 152 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 82,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Laderly Soil
Mean site index for stated species: Douglas-fir - 135 (based on 100-year site curve); 111 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old

General management considerations:

Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Susceptibility of cut and fill areas to erosion is moderate.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
Soil compaction increases if yarding and skid trails converge.
Areas on ridgetops that are exposed to strong, persistent winds are less productive than other areas.
Trees on the Laderly soil are subject to windthrow because of the limited rooting depth.
Trees on the Laderly soil are subject to windthrow when the soil is excessively wet and winds are strong.
The limited available water capacity of the Laderly soil increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil; seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.

To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

9E-Caterl-Laderly complex, 30 to 60 percent slopes.

Composition
Caterl soil and similar inclusions - 45 percent
Laderly soil and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Caterl Soil
Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry, salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 12 inches - dark brown gravelly loam
12 to 28 inches - brown gravelly loam
28 to 43 inches - brown extremely gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Laderly Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry, salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Typical profile:
0 to 16 inches - very dark brown and dark brown very gravelly loam
16 to 21 inches - dark brown very gravelly loam
21 to 37 inches - dark brown extremely cobbly loam
37 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage c/ass: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have siltstone at a depth of 20 inches or more
Soils that have basalt at a depth of less than 20 inches
Rock outcroppings
Soils that have less than 35 percent rock fragments throughout the profile

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, gravel, cobbles in some areas, depth to bedrock in some areas, rooting depth in some areas, available water capacity in some areas, low extractable phosphorus
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland
Caterl Soil
Mean site index for stated species: Douglas-fir - 145 (based on 100-year site curve); 115 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 152 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 82,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Laderly Soil
Mean site index for stated species Douglas-fir - 135 (based on 100-year site curve); 111 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Adequately designed road drainage reduces the risk of erosion.
Trees on the Laderly soil are subject to windthrow because of the limited rooting depth.
Trees on the Laderly soil are subject to windthrow when the soil is excessively wet and winds are strong.
The limited available water capacity of the Laderly soil increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

10B-Chitwood silt loam, 0 to 7 percent slopes.

Composition
Chitwood soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Chitwood Soil

Position on landscape: Terraces
Slope range: 0 to 7 percent
Elevation: 50 to 300 feet
Native plants: Sitka spruce, western hemlock, western redcedar, red alder, rushes, sedges, grasses
Typical profile:
0 to 11 inches - very dark grayish brown silt loam
11 to 22 inches - dark brown, mottled silty clay loam
22 to 50 inches - brown and light olive brown, mottled silty clay
50 to 60 inches - variegated silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Permeability: Slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 20 to 40 inches for water tolerant plants
Runoff: Slow
Hazard of erosion by water: Slight
Depth to water table: November through March - 12 to *36* inches

Included Areas
Soils that have slopes of more than 7 percent
Soils that are poorly drained or moderately well drained
Soils that have less than *35* percent clay between depths of 10 and 40 inches
Soils that are sandy between depths of 10 and 60 inches

Major Uses
Cropland, homesites, wildlife habitat .

Major Management Factors
Soil-related factors Permeability, wetness, rooting depth, load supporting capacity, susceptibility of the upper layer to compaction, shrink-swell potential
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to *52* degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 245 days

Cropland
General management considerations:
Water tolerant plants can be grown.
Suitable crops for planting are grasses and legumes.
Wetness limits the choice of plants and the period of grazing.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.

Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
The content of soil moisture is optimum for tillage for only a short period.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Lower the water table by installing a drainage system.
Install subsurface drains or drainage ditches, or both.
Use tile drains to intercept runoff from higher lying areas.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting early in August to provide adequate cover in winter.
Maintain the quality and quantity of forage by rotating grazing, mowing and clipping, discouraging selective grazing, limiting grazing to drier periods, controlling weeds, and applying fertilizer annually.

Building Site Development

General management-considerations:
Excavation increases the risk of water erosion.
Cutbanks are not stable and therefore are subject to slumping.
The quality of roadbeds and road surfaces can be adversely affected by shrinking and swelling and limited soil strength.
Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Reduce wetness by providing drainage around buildings with basements and crawl spaces and installing drain tile around footings.
Design buildings and roads to offset the limited ability of the soil to support a load.
Prevent structural damage that results from shrinking and swelling by backfilling with material that has low shrink-swell potential, properly designing foundations and footings, and diverting runoff away from buildings.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.
Seed road cuts and fills to permanent vegetation.

10C-Chitwood silt loam, 7 to 15 percent slopes.

Composition
Chitwood soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Chitwood Soil

Position on-landscape: Terraces
Slope range: 7 to 15 percent
Elevation: 50 to 300 feet
Native plants: Sitka spruce, western hemlock, western redcedar, red alder, rushes, sedges, grasses
Typical profile:
0 to 11 inches - very dark grayish brown silt loam
11 to 22 inches - dark brown, mottled silty clay loam
22 to 50 inches - brown and light olive brown, mottled silty clay
50 to 60 inches - variegated silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Permeability: Slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 20 to 40 inches for water tolerant plants
Runoff: Medium
Hazard of erosion by water: Moderate
Depth to water table: November through March - 12 to 36 inches

Included Areas

Soils that have slopes of less than *7* percent or more than 15 percent
Soils that are poorly drained or moderately well drained
Soils that are less than 35 percent clay between depths of 10 and 40 inches
Soils that are sandy between depths of 10 and 60 inches

Major Uses

Cropland, homesites, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, permeability, wetness, rooting depth, load supporting capacity, susceptibility of the upper layer to compaction, shrink-swell potential

Climatic factors (mean annual):

Precipitation - 70 to 100 inches

Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)

Frost-free period - 210 to 245 days

Cropland

General management considerations:

Water tolerant plants can be grown.

Suitable crops for planting are grasses and legumes.

Wetness limits the choice of plants and the period of grazing.

Drainage should be maintained throughout the growing season.

Most crops respond to nitrogen, phosphorus, potassium, and lime.

Legumes respond to phosphorus and lime. Additions of potassium may also be needed.

The content of soil moisture is optimum for tillage for only a short period.

Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Select plants that tolerate wetness or provide drainage.

Lower the water table by installing a drainage system.

Install subsurface drains or drainage ditches, or both.

Use tile drains to intercept runoff from higher lying areas.

Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.

Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, planting early in August to provide adequate cover in winter, tilling and seeding on the contour or across the slope, and maintaining crop residue on or near the surface.

Maintain the quality and quantity of forage by adjusting stocking rate, especially on the steeper slopes; rotating grazing; mowing and clipping; discouraging selective grazing; limiting grazing to drier periods; controlling weeds; and applying fertilizer annually.

Building Site Development

General management considerations:

Excavation increases the risk of water erosion.

Cutbanks are not stable and therefore are subject to slumping.

The quality of roadbeds and road surfaces can be adversely affected by shrinking and swelling and limited soil strength.

Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.

Untreated effluent can move along the surface of the slowly permeable layer and seep in downslope areas, creating a health hazard.

If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Design and construct buildings and access. roads to compensate for the steepness of slope.

Reduce wetness by providing drainage around buildings with basements and crawl spaces and installing drain tile around footings.

Install septic tank absorption lines in adjacent areas that are more nearly level.

In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.

Preserve the existing plant cover during construction to reduce the risk of erosion.

Design buildings and roads to offset the limited ability of the soil to support a load.

Prevent structural damage that results from shrinking and swelling by backfilling with material that has low shrink-swell potential, properly designing foundations and footings, and diverting runoff away from buildings.

Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.

Because the soil is subject to slumping, especially in the steeper areas, locate roads in the more gently sloping areas and design drainage systems to minimize the risk of slumping.

Provide a stable base and an adequate wearing surface to improve trafficability of roads.

Install culverts to carry seasonal runoff where roads cross natural drainageways.

Seed road cuts and fills to permanent vegetation.

11A-Coquille-Clatsop complex, 0 to 1 percent slopes.

Composition
Coquille soil and similar inclusions - 60 percent
Clatsop soil and similar inclusions - 30 percent
Contrasting inclusions - 10 percent

Coquille Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 1 percent
Elevation: 5 to 10 feet
Native plants: Willow, salmonberry, rushes, sedges, grasses
Typical profile:
0 to 6 inches - very dark gray silt loam
6 to 30 inches - dark grayish brown, mottled silt loam
30 to 60 inches - dark gray silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Permeability: Slow
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: 24 inches above the surface to 24 inches below the surface throughout the year
Frequency of flooding: Frequent throughout the year

Clatsop Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 1 percent
Elevation: 5 to 10 feet
Native plants: Cattail, horsetail, rushes, sedges, skunkcabbage, grasses
Typical profile:
0 to 6 inches - very dark grayish brown muck
6 to 24 inches - very dark grayish brown and dark gray silt loam
24 to 60 inches - very dark gray silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Permeability: Slow
Available water capacity: 11 to 14 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: 24 inches above the surface to 24 inches below the surface throughout the year
Frequency of flooding: Frequent throughout the year

Included Areas
Soils that are organic between depths of 15 and 36 inches
Soils that are more than *35* percent clay between depths of 10 and 40 inches
Soils that are sandy between depths of 20 and 40 inches
Soils that are sandy throughout the profile

Major Use
Wetland wildlife habitat

Major Management Factors
Soil-related factors: Flooding, plant competition, wetness
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 220 days

12A-Coquille-Clatsop complex, protected, 0 to 1 percent slopes.

Composition
Coquille soil and similar inclusions - 60 percent
Clatsop soil and similar inclusions - 30 percent
Contrasting inclusions - 10 percent

Coquille Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 1 percent
Elevation: 5 to 10 feet
Native plants: Red alder, willow, sedges, rushes, grasses
Typical profile:
0 to 6 inches - very dark gray silt loam
6 to 30 inches - dark grayish brown, mottled silt loam
30 to 60 inches - dark gray silt loam
Depth class: Very deep (more than *60* inches)
Drainage class: Very poorly drained
Permeability: Slow
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: November through June - 6 inches above the surface to 24 inches below the surface
Frequency of flooding: Rare

Clatsop Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 1 percent
Elevation: 5 to 10 feet
Native plants: Rushes, sedges, cattail, skunkcabbage; grasses

Typical profile:
0 to 6 inches - very dark grayish brown muck
6 to 24 inches - very dark grayish brown and dark gray silt loam
24 to 60 inches - very dark gray silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Permeability: Slow
Available water capacity: 11 to 14 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: November through June - 6 inches above the surface to 24 inches below the surface
Frequency of flooding: Rare

Included Areas

Soils that are organic between depths of 15 and 36 inches
Soils that are more than 35 percent clay between depths of 10 and 40 inches
Soils that are sandy between depths of 20 and 40 inches
Soils that are sandy throughout the profile

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Flooding, inadequate drainage outlets, wetness, rooting depth, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 220 days

Cropland

General management considerations:
Most climatically adapted crops can be grown if adequate drainage and protection from flooding are provided.
Suitable crops for planting are grasses and legumes.
Wetness limits the period of time suitable for planting, the choice of plants, the period of grazing, and the production of deep-rooted crops.
Drainage should be maintained throughout the growing season.
Providing drainage is difficult because many areas have poor outlets.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Prepare the seedbed only when the soil is adequately dry.
Provide water control structures to reduce the risk of flooding.
Install subsurface drains to reduce wetness if a suitable outlet is available.
Install surface drains to reduce the length of the periods of ponding and to inhibit the growth of the less palatable water tolerant plants.
Use open ditches or tile drains to remove water on or near the surface.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by mowing and clipping, controlling weeds, applying fertilizer annually, limiting grazing to drier periods, and rotating grazing.

13A-Coquille Variant silt loam, 0 to 1 percent slopes.

Composition

Coquille Variant soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Coquille Variant Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 1 percent
Elevation: 5 to 15 feet
Native plants: Red alder, willows, sedges, rushes, grasses
Typical profile:
0 to 4 inches - dark brown silt loam
4 to *22* inches - dark grayish brown, mottled silt loam
22 to 35 inches - grayish brown, mottled silty clay loam and dark gray, mottled sandy clay loam
35 to 60 inches - dark gray, mottled fine sand and very dark grayish brown fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Permeability: Slow
Available water capacity: 7 to 11 inches

Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: November through June - 6 inches above the surface to 36 inches below the surface
Frequency of flooding: Rare

Included Areas

Soils that are muck in the upper 15 inches
Soils that are organic between depths of 15 and 36 inches
Soils that are silt loam or silty clay loam throughout the profile
Soils that are more than 35 percent clay between depths of 20 and 40 inches

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Flooding, inadequate drainage outlets, wetness, rooting depth, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 220 days

Cropland

General management considerations:
Most climatically adapted crops can be grown if adequate drainage and protection from flooding are provided.
Suitable crops for planting are grasses and legumes.
Wetness limits the choice of plants, the period of grazing, and the production of deep-rooted crops.
Drainage should be maintained throughout the growing season.
Providing drainage is difficult because many areas have poor outlets.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Provide water control structures to reduce the risk of flooding.
Install subsurface drains to reduce wetness if a suitable outlet is available.
Install surface drains to reduce the length of the periods of ponding and to inhibit the growth of the less palatable -water tolerant plants.
Use open ditches or tile drains to remove water on or near the surface.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by mowing and clipping, controlling weeds, applying fertilizer annually, limiting grazing to drier periods, and rotating grazing.

14A-Croquib silt loam, 0 to 3 percent slopes.

Composition

Croquib soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Croquib Soil

Position on landscape: Stream terraces
Slope range: 0 to 3 percent
Elevation: 25 to 500 feet
Native plants: Sitka spruce, western hemlock; red alder, salmonberry, salal, sedges, rushes
Typical profile:
0 to 6 inches - black and very dark gray, mottled silt loam
6 to 13 inches - dark gray, mottled silty clay loam
13 to 34 inches - light brownish gray, mottled silty clay loam
34 to 60 inches - brownish gray, mottled, consolidated extremely gravelly loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Permeability. Very slow
Available water capacity. 6 to 11 inches
Potential rooting depth: 25 to 40 inches for water tolerant plants
Runoff.- Slow
Hazard of erosion by water.- Slight
Depth to perched water table: November through May - 0.5 inch above the surface to 24 inches below the surface

Included Areas

Soils that are moderately well drained Soils that are not consolidated and gravelly in the lower part

Major Uses
Cropland, wildlife habitat

Major Management Factors
Soil-related factors: Wetness, rooting depth, permeability, low extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown if adequate drainage is provided.
Suitable crops for planting are grasses and legumes.
Wetness limits the period of grazing.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer; poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Lower the water table by installing a drainage system.
Use open ditches or tile drains to remove water on or near the surface.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

15-Dune land.

Composition
Dune land - 85 percent
Contrasting inclusions - 15 percent

Dune Land

Slope range: 3 to 30 percent
Elevation: 10 to 40 feet
Native plants: Beachgrasses
Reference profile:
0 to 60 inches - light brownish gray fine sand
Potential rooting depth: 20 inches or more
Hazard of erosion: By water - severe; by wind – severe (fig. 3)

Included Areas

Soils that are wet

Major Uses
Wildlife habitat, recreation

Major Management Factors
Soil-related factors: Erosion by wind, erosion of foredune areas during extreme high tides and storms, load supporting capacity
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Frost-free period - 200 to 245 days

16D-Ecola silt loam, 3 to 30 percent slopes.

Composition

Ecola soil and similar inclusions - 90 percent
Contrasting inclusions - 10 percent

Ecola Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salmonberry, salal, red huckleberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:
0 to 7 inches - very dark grayish brown silt loam
7 to 16 inches - dark brown silty clay loam
16 to 37 inches - dark, yellowish brown silty clay loam
7 inches - weathered siltstone
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 4 to 10 inches
Potential rooting depth: 20 to 40 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have weathered siltstone at a depth of more than 40 inches

Figure 3.-Erosion in an area of Dune land.

Soils that are wet

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Depth to bedrock, rooting depth, water erosion, susceptibility of the upper layer to compaction
Climatic factors (average annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Western hemlock - 159 (based on 100-year site curve); 117 (based on 50-year site curve)
Estimated total production per acre: 110,110 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 252 cubic feet per acre in a stand of 50-year-old trees 1.5 inches in diameter at breast height.

Mean site index for stated species: Douglas-fir - 161 (based on 100-year site curve); 126 (based on 50-year site curve)

General management considerations:

Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.

Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.

When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Logging roads require suitable surfacing for year-round use.

Susceptibility of cut and fill areas to erosion is moderate.

Adequately designed road drainage reduces the risk of erosion.

Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.

Cutbanks occasionally slump when saturated.

Spoil from excavations is subject to rill and gully erosion and to sloughing.

Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.

Soil compaction increases if yarding and skid trails converge.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Because roots are restricted by bedrock, trees commonly are subject to windthrow.

Windthrow is a hazard when the soil is saturated and winds are strong.

Reforestation occurs naturally in cutover areas if a seed source is present.

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

Carefully managed reforestation reduces competition from undesirable understory plants.

Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.

Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.

To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.

Avoid excessive damage to the soil and to the . vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

16F-Ecola-Templeton silt loams, 60 to 90 percent slopes.

Composition

Ecola soil and similar inclusions - 50 percent
Templeton soil and similar inclusions - 35 percent
Contrasting inclusions - 15 percent

Ecola Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salmonberry, salal, red huckleberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:

0 to 7 inches - very dark grayish brown silt loam
7 to 16 inches - dark brown silty clay loam
16 to 37 inches - dark yellowish brown silty clay loam
37 inches - weathered siltstone

Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 9 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Templeton Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 100 to 1,600 feet
Native plants: Sitka spruce, western hemlock, Douglas-fir, red alder, salmonberry, salal, red huckleberry, western swordfern, Oregon oxalis
Typical profile:

0 to 12 inches - very dark grayish brown and dark brown silt loam

12 to 58 inches - dark yellowish brown and yellowish brown silty clay loam
58 inches - weathered siltstone

Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 40 to 60 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 60 percent
Soils that have basalt at a depth of 20 to 60 inches
Soils that have weathered siltstone at a depth of less than 20 inches
Soils that have more than 35 percent hard rock fragments between depths of 10 and 60 inches
Rock outcroppings

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, water erosion, depth to bedrock in some areas, rooting depth in some areas
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland

Ecola Soil
Mean site index for stated species: Western hemlock - 159 (based on 100-year site curve); 117 (based on 50-year site curve)
Estimated total production per acre: 110,110 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 252 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 161 (based on 100-year site curve); 126 (based on 50-year site curve)
Templeton Soil
Mean site index for stated species: Western hemlock - 166 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 115,780 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches in diameter at breast height
Mean site index for stated species: Douglas-fir - 165 (based on 100-year site curve); 125 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 180 (based on 100-year site curve)

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is high.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
The soil in this unit is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
Adequately designed road drainage reduces the risk of erosion.
Cutbanks occasionally slump when saturated.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
The waste material from roadbuilding can, damage vegetation. It is also a potential source of sedimentation.
Because roots are restricted by bedrock, trees on the Ecola soil commonly are subject to windthrow.
Windthrow is a hazard on the Ecola soil when it is saturated and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

17A-Eilertsen silt loam, 0 to 3 percent slopes.

Composition
Eilertsen soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Eilertsen Soil
Position on landscape: Stream terraces
Slope range: 0 to 3 percent
Elevation: 300 to 600 feet
Native plants: Douglas-fir, western hemlock, western redcedar, red alder, bigleaf maple, vine maple, common snowberry, red huckleberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, leaves, and twigs 1 inch thick
Typical profile:
0 to 18 inches - very dark brown silt loam
18 to 28 inches - dark yellowish brown silty clay loam
28 to 60 inches - dark yellowish brown silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight

Included Areas

Soils that are wet Soils that are more than *35* percent clay between depths of 10 and 40 inches

Major Uses
Cropland, homesites, wildlife habitat (fig. 4)

Major Management Factors
Soil-related factors: Susceptibility of the upper layer to compact, load supporting capacity, shrink-swell potential
Climatic factors (mean annual):
Precipitation - 60 to *80* inches
Soil temperature - 49 to *52* degrees F
Frost-free period - 145 to 210 days

Cropland

General management considerations:
Most climatically adapted crops can be grown.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Building Site Development
General management considerations:
Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by shrinking and swelling and limited soil strength.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Stockpile topsoil and use it to reclaim areas disturbed during construction.
Design buildings and roads to offset the limited ability of the soil to support a load.
Prevent structural damage that results from shrinking and swelling by backfilling with material that has low shrink-swell potential.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Provide a-stable base and an adequate wearing surface to improve trafficability.
Install culverts to carry seasonal runoff where roads cross natural drainageways.

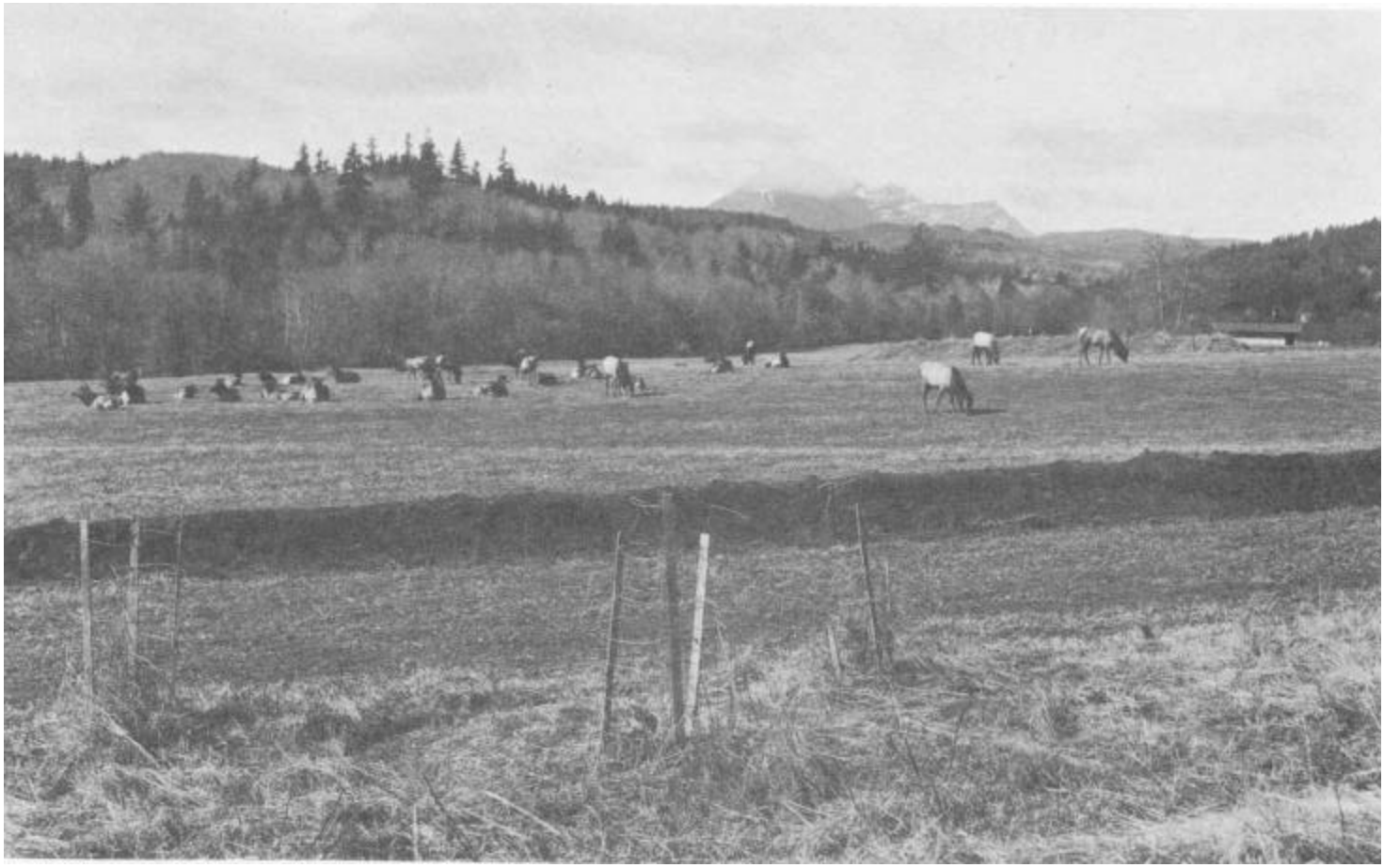

Figure 4.-Elk grazing in an area of Eilertsen silt loam, 0 to 3 percent slopes, in Jewell Wildlife Refuge.

18B-Elsie silt loam, 0 to 7 percent slopes.

Composition
Elsie soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Elsie Soil

Position on landscape: Terraces
Slope range: 0 to 7 percent
Elevation: 400 to 600 feet
Native plants: Douglas-fir, western hemlock, bigleaf maple, red alder, vine maple, western swordfern, salal, red huckleberry
Organic mat on surface: Moss, needles, leaves, and twigs *2* inches thick
Typical profile:
0 to *24* inches - very dark brown and very dark grayish brown silt loam
24 to *50* inches - dark yellowish brown silt loam
50 to 60 inches - yellowish brown loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight

Included Areas
Soils that have slopes of more than 7 percent
Soils that are wet
Soils that are more than *35* percent clay between depths of 10 and 40 inches

Major Uses
Cropland, woodland, homesites, wildlife habitat

Major Management Factors
Soil-related factors: Load supporting capacity, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to *52* degrees F

Frost-free period - 145 to 210 days

Cropland

General management considerations:

- Most climatically adapted crops can be grown.
- Suitable crops for planting are grasses and legumes.
- Grasses and legumes grow well if they are adequately fertilized.
- Sprinkler irrigation is suited to this unit.
- Most crops respond to nitrogen, phosphorus, potassium, and lime.
- Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
- Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

- Irrigate during the dry period in summer.
- Regulate the application of irrigation water to control runoff and erosion.
- Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
- Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
- Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting early in spring to provide adequate cover in winter.
- Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Woodland

Estimated mean site index for stated species: Douglas-fir - 170 (based on 100-year site curve)

Estimated total production per acre: 102,800 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old

Estimated growth at culmination of mean annual increment (CMAI): 181 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

- Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
- Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
- When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
- Logging roads require suitable surfacing for year-round use.
- Cutbanks occasionally slump when saturated.
- Adequately designed road drainage reduces the risk of erosion.
- Soil compaction increases if yarding and skid trails converge.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
- Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:

- Use conventional equipment in harvesting, but limit its use when the soil is wet.
- Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
- To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
- Prepare the site carefully to control competing vegetation.
- Hand plant nursery stock to establish or improve a stand.
- Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development

General management considerations:

- Excavation increases the risk of water erosion.
- The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
- If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

- Reduce the risk of erosion and the maintenance cost by stabilizing areas that have been disturbed.
- Stockpile topsoil and use it to reclaim areas disturbed during construction.
- Design buildings and roads to offset the limited ability of the soil to support a load.
- Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
- Provide a stable base and an adequate wearing surface to improve trafficability of roads.
- Install culverts to carry seasonal runoff where roads cross natural drainageways.

Seed road cuts and fills to permanent vegetation.

18C-Elsie silt loam, 7 to 15 percent slopes.

Composition
Elsie soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Elsie Soil
Position on landscape: Terraces
Slope range: 7 to 15 percent
Elevation: 400 to 600 feet
Native plants: Douglas-fir, western hemlock, bigleaf maple, red alder, vine maple; western swordfern, salal, red huckleberry
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to *24* inches - very dark brown and very dark grayish brown silt loam
24 to 50 inches - dark yellowish brown silt loam
50 to 60 inches - yellowish brown loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas
Soils that have slopes of less than *7* percent or more than *15* percent
Soils that are wet Soils that are more than *35* percent clay between depths of 10 and *40* inches

Major Uses
Cropland, woodland, homesites, wildlife habitat

Major Management Factors
Soil-related factors: Erosion by water in some areas, , load supporting capacity, slope in some areas
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland
General management considerations:
Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, planting early in spring to provide adequate cover in winter, and tilling on the contour or across the slope.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; limiting grazing to drier periods; mowing and clipping; controlling weeds; and applying fertilizer annually.

Woodland
Estimated mean site index for stated species: Douglas-fir - 170 (based on 100-year site curve)
Estimated average annual production per acre: 102,800 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old
Estimated growth at culmination of mean annual increment (CMAI): 181 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Soil compaction increases if yarding and skid trails converge.

Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development
General management considerations:
Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Design and construct buildings and access roads to compensate for the steepness of slope.
Reduce the risk of erosion and the maintenance cost by stabilizing areas that have been disturbed.
Use temporary sediment or debris basins to reduce the loss of soil material from construction sites.
Stockpile topsoil and use it to reclaim areas disturbed during construction.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.
Seed road cuts and fills to permanent vegetation.

19C-Gearhart fine sandy loam, 3 to 15 percent slopes.

Composition
Gearhart soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Gearhart Soil

Position on landscape: Stabilized dunes
Slope range: 3 to 15 percent
Elevation: 15 to 70 feet
Native plants: Shore pine, Sitka spruce, grasses, Scotch-broom, salal, strawberries, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 11 inches - black fine sandy loam
11 to 16 inches - dark brown loamy fine sand
16 to 45 inches - dark gray fine sand
45 to 60 inches - gray sand
Depth class: Very deep (60 inches or more)
Drainage class: Somewhat excessively drained
Permeability: Rapid
Available water capacity: 4 to 7 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion: By water - slight; by wind - moderate

Included Areas
Soils that have slopes of more than 15 percent
Soils that are wet
Soils that have a layer of iron accumulation in the profile

Major Uses
Cropland, homesites, wildlife habitat

Major Management Factors
Soil-related factors: Erosion by wind, permeability, hazard of seepage
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to *53* degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to *245* days

Cropland
General management considerations:
Most climatically adapted crops can be grown.

Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
The high content of sand reduces the amount of moisture available to plants.

Suitable management practices:
Irrigate during the dry period in summer.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Reduce the risk of wind erosion by maintaining a plant cover and using minimum tillage.
Maintain the quality and quantity of forage by rotating grazing, mowing and clipping, controlling weeds, and applying fertilizer annually.

Building Site Development
General management considerations:
Excavation for roads can expose material that is highly susceptible to wind erosion.
Cutbanks are not stable and therefore are subject to slumping.
Onsite sewage disposal systems may not be suitable because of the risk of polluting the ground water.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
Design buildings and roads to offset the limited ability of the soil to support a load.
Seed road cuts and fills to permanent vegetation.

19D-Gearhart fine sandy loam, 15 to 30 percent slopes.

Composition
Gearhart soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Gearhart Soil

Position on landscape: Dunes
Slope range: 15 to 30 percent
Elevation: 25 to 70 feet
Native plants: Shore pine, Sitka spruce, grasses, Scotch-broom, salal, strawberries, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 11 inches - black fine sandy loam
11 to 16 inches - dark brown loamy fine sand
16 to 45 inches - dark gray fine sand
45 to 60 inches - gray sand
Depth class: Very deep (60 inches or more)
Drainage class: Somewhat excessively drained
Permeability: Rapid
Available water capacity: 4 to 7 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion: By water - slight; by wind - moderate

Included Areas

Soils that have slopes of less than 15 percent

Major Uses
Wildlife habitat, cropland; homesites

Major Management Factors
Soil-related factors: Erosion by wind in some areas, permeability, hazard of seepage
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
The high content of sand reduces the amount of moisture available to plants.

Suitable management practices:
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Reduce the risk of erosion by using minimum tillage and seeding disturbed areas to native or tame pasture plants.
Reduce the risk of wind erosion by maintaining a plant cover and using minimum tillage.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; discouraging selective grazing; controlling weeds; and applying fertilizer annually.

Building Site Development

General management considerations:

Excavation can expose soil material that is highly susceptible to wind erosion.

Cutbanks are not stable and therefore are subject to slumping.

Onsite sewage disposal systems may not be suitable because of the risk of polluting the ground water.

If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Design and construct buildings and access roads to compensate for the steepness of slope.

Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.

In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction. .

Design buildings and roads to offset the limited ability of the soil to support a load.

20B-Grindbrook silt loam, 0 to 7 percent slopes.

Composition

Grindbrook soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Grindbrook Soil

Position on landscape: Terraces
Slope range: 0 to 7 percent
Elevation: 100 to 350 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salal, salmonberry, red huckleberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:

0 to 15 inches - black to very dark brown silt loam
15 to 28 inches - dark brown silt loam
28 to 60 inches - brown and gray, mottled silty clay loam

Depth class: Very deep (60 inches or more)
Drainage class: Moderately well drained
Permeability: Moderately slow
Available water capacity: 9 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight
Depth to perched water table: November through May - 24 to *36* inches

Included Areas

Soils that are poorly drained or somewhat poorly drained
Soils that are clayey between depths of 10 and 40 inches
Soils that are well drained
Soils that have slopes of more than 7 percent
Soils that have partially weathered, waterworn rock fragments at a depth of 25 inches or more

Major Uses

Cropland, woodland, homesites, wildlife habitat

Major Management Factors

Soil-related factors: Permeability, wetness, load supporting capacity, susceptibility of the upper layer to compaction
Climatic factors (mean annual):

Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less then 9 degrees from summer to winter)
Frost-free period - 180 to 210 days

Cropland

General management considerations:

Most climatically adapted crops can be grown if adequate drainage is provided.

Wetness limits the production of deep-rooted crops.

Suitable crops for planting are grasses and legumes.

Grasses and legumes grow well if they are adequately fertilized.

Most crops respond to nitrogen, phosphorus, potassium, and lime.

Legumes respond to phosphorus and lime. Additions of potassium may also be needed.

Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Select plants that tolerate wetness or provide drainage.

Use tile drains to reduce wetness if a suitable outlet is available.

Irrigate during the dry period in summer.

Regulate the rate of irrigation to prevent the development of a perched water table.

Regulate the application of irrigation water to control runoff and erosion.

Apply enough water to wet the root zone but not so much that it leaches plant nutrients.

Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.

Reduce the risk of erosion by planting early in spring to provide adequate cover in winter.

Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, and applying fertilizer annually.

Woodland

Mean site index for stated species: Western hemlock - 166 (based on 100-year site curve); 120 (based on 50-year site curve)

Estimated total production per acre: 115,780 board feet (International rule, one-fourth-inch kerf) from a stand of trees 70 years old

Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.

Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.

When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Cutbanks occasionally slump when saturated.

Adequately designed road drainage reduces the risk of erosion.

Spoil from excavations is subject to rill and gully erosion and to sloughing.

Soil compaction increases if yarding and skid trails converge.

Logging roads require suitable surfacing for year-round use.

Windthrow is a hazard when the soil is saturated and winds are strong.

Reforestation occurs naturally in cutover areas if a seed source is present.

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

Carefully managed reforestation reduces competition from undesirable understory plants.

Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.

Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding -roads and landings, installing water bars and culverts, and seeding cuts and fills.

To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development

General management considerations:

Excavation increases the risk of water erosion.

Road cutbanks are subject to slumping.

The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.

Septic tank absorption fields may function poorly because of the restricted permeability of the soil and seasonal wetness.

If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Reduce wetness by installing drain tile around footings.

Design buildings and roads to offset the limited ability of the soil to support a load.

Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.

Increase the size of the septic tank absorption field to compensate for the restricted permeability.

Provide a stable base and an adequate wearing surface to improve trafficability of roads.

20C-Grindbrook silt loam, 7 to 20 percent slopes.

Composition

Grindbrook soil and similar inclusions - 85 percent

Contrasting inclusions - 15 percent

Grindbrook Soil

Position on landscape: Terraces

Slope range: 7 to 20 percent

Elevation: 100 to 350 feet

Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salmonberry, salal, red huckleberry, western swordfern, Oregon oxalis

Organic mat on surface: Moss, needles, and twigs 1 inch thick

Typical profile:

0 to 15 inches - black to very dark brown silt loam

15 to 28 inches - dark brown silt loam

28 to 60 inches - brown and gray, mottled silty clay loam

Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Permeability: Moderately slow
Available water capacity: 9 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate
Depth to perched water table: November through May - 24 to 36 inches

Included Areas

Soils that are poorly drained or somewhat poorly drained
Soils that are clayey between depths of 10 and 40 inches
Soils that are well drained
Soils that have slopes of less than 7 percent or more than 20 percent
Soils that have partially weathered, waterworn rock fragments at a depth of 25 inches or more

Major Uses
Cropland, woodland, homesites, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, permeability, wetness, load supporting capacity, susceptibility to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 210 days

Cropland
General management considerations:
Most climatically adapted crops can be grown if adequate drainage is provided.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Use tile drains to reduce wetness if a suitable outlet is available.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by tilling on the contour or across the slope and planting early in spring to provide adequate cover in winter.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; limiting grazing to drier periods; and applying fertilizer annually.

Woodland
Mean site index for stated species: Western hemlock - 166 (based on 100-year site curve); 120 (based on 50-year site curve)
Estimated total production per *acre:* 115,780 board feet . (International rule, one-fourth-inch kerf) from a stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Windthrow is a hazard when the soil is saturated and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not-prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.

Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.

Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.

To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development

General management considerations:

Excavation increases the risk of water erosion.

Road cutbanks are subject to slumping.

The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.

Septic tank absorption fields may function poorly because of the restricted permeability of the soil and seasonal wetness.

If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Design and construct buildings and access roads to compensate for the steepness of slope.

Reduce wetness by installing drain tile around footings.

In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.

Design buildings and roads to offset the limited ability of the soil to support a load.

Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.

Increase the size of the septic tank absorption field to compensate for the restricted permeability.

Install septic tank absorption lines in adjacent areas that are more nearly level.

Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.

Provide a stable base and an adequate wearing surface to improve trafficability of roads.

When roadbuilding, stabilize disturbed areas to reduce the risk of erosion and the maintenance cost resulting from erosion.

21D-Grindbrook silt loam, bedrock substratum, 3 to 30 percent slopes.

Composition

Grindbrook soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Grindbrook Soil

Position on landscape: Terraces
Slope range: 3 to 30 percent
Elevation: 125 to 500 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salmonberry, red huckleberry, salal, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to *17* inches - very dark brown and very dark grayish brown silt loam
17 to 37 inches - dark brown, brown, and yellowish brown silty clay loam that is mottled in the lower part
37 to 50 inches - gray, mottled silty clay loam
50 inches - weathered siltstone
Depth class: Deep (40 to 60 inches)
Drainage class: Moderately well drained
Permeability: Moderately slow
Available water capacity: 9 to *12* inches
Potential rooting depth: 40 to 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate
Depth to perched water table: November through May – 24 to *36* inches

Included Areas

Soils that have slopes of more than 30 percent
Soils that are poorly drained or somewhat poorly drained
Soils that are clayey between depths of 10 and 30 inches
Soils that are well drained

Major Uses

Homesites, woodland, cropland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, water erosion, load supporting capacity, permeability, wetness, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches

Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 210 days

Cropland

Most climatically adapted crops can be grown if adequate drainage is provided.
Wetness limits the production of deep-rooted crops.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Plant deep-rooted crops in areas where natural drainage is adequate or where a drainage system has been installed.
Use tile drains to reduce wetness if a suitable outlet is available.
Use tile drains to intercept runoff from higher lying areas.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Reduce the risk of erosion by using minimum tillage and seeding disturbed areas to native or tame pasture plants.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; limiting grazing to drier periods; discouraging selective grazing; controlling weeds; and applying fertilizer annually.

Woodland

Mean site index for stated species: Western hemlock - 166 (based on 100-year site curve); 120 (based -on 50-year site curve)
Estimated total production per acre: 115,780 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter, at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is moderate.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.-
Adequately designed road drainage reduces the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Windthrow is a hazard when the soil is saturated and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, and Douglas-fir seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is Wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development
General management considerations:
Excavation increases the risk of water erosion.
Road cutbanks are subject to slumping.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.

Septic tank absorption fields may function poorly because of the restricted permeability of the soil and seasonal wetness.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Design and construct buildings and access roads to compensate for the steepness of slope.
Reduce wetness by installing drain tile around footings.
In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Increase the size of the septic tank absorption field to compensate for the restricted permeability.
Install septic tank absorption lines in adjacent areas that are more nearly level.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
When roadbuilding, stabilize disturbed areas to reduce the risk of erosion and the maintenance cost resulting from erosion.

22F-Harslow-Kilchis very gravelly loams, 60 to 90 percent slopes.

Composition
Harslow soil and similar inclusions - 50 percent
Kilchis soil and similar inclusions - 35 percent
Contrasting inclusions - 15 percent

Harslow Soil
Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, cascade Oregon-grape, salal, vine maple, red huckleberry, western swordfern
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 18 inches - dark brown very gravelly loam
18 to 24 inches - brown very cobbly loam
24 to 34 inches - brown extremely gravelly loam
34 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Kilchis Soil

Position on landscape: Mountainsides.
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, vine maple, western swordfern, red huckleberry, salmonberry
Typical profile:
0 to 10 inches - dark brown very gravelly loam
10 to 18 inches - dark brown extremely cobbly loam
18 inches - basalt
Depth class: Shallow (10 to 20 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 1 to 3 inches
Potential rooting depth: 10 to 20 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have bedrock at a depth of more than 40 inches Rock outcroppings Soils that have slopes of less than 60 percent or more than 90 percent

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, depth to bedrock, gravel and cobbles, available water capacity, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 47 to 51 degrees F
Frost-free period - 100 to 210 days

Woodland

Harslow Soil
Mean site index for stated species: Douglas-fir – 135 (based on 100-year site curve); 98 (based on 50 -year site curve)
Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

Kilchis Soil

Mean site index for stated species: Douglas-fir - 119 (based on 100-year site curve); 90 (based on 50-year site curve)

Growth at culmination of mean annual increment (CMAI): 113 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Estimated total production per acre: 62,460 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 90 years old

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.

Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.

Maintaining the understory vegetation is essential in controlling erosion.

Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.

Logging roads require suitable surfacing for year-round use.

Susceptibility of cut and fill areas to erosion is moderate.

Adequately designed road drainage reduces the risk of erosion.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Rock for road construction is available in this unit.

Because roots are restricted by bedrock, trees commonly are subject to windthrow.

Windthrow is a hazard when the soil is saturated and winds are strong.

The limited available water capacity increases seedling mortality.

Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.

Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:

Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.

Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Manage regeneration carefully to reduce the competition of less desirable plants and provide shade for seedlings.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

23A-Hebo silty clay loam, 0 to 3 percent slopes.

Composition

Hebo soil and similar inclusions - 85 percent

Contrasting inclusions - 15 percent

Hebo Soil

Position on landscape: Terraces

Slope range: 0 to 3 percent

Elevation: 50 to 100 feet

Native plants: Sitka spruce, western hemlock, red alder, salmonberry, salal, sedges, rushes

Typical profile:

0 to 5 inches - black silty clay loam

5 to 11 inches - black, mottled silty clay

11 to 38 inches - dark gray and gray, mottled clay and silty clay

38 to 60 inches - light brownish gray, mottled silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Permeability: Very slow

Available water capacity: 10 to 12 inches

Potential rooting depth: 10 to 30 inches for water tolerant plants

Runoff: Slow

Hazard of erosion by water: Slight

Depth to water table: November through June - 6 inches above the surface to 12 inches below the surface

Included Areas

Soils that are somewhat poorly drained or moderately well drained .

Soils that have less clay throughout the profile

Soils that have a gravelly or cobbly layer at a depth of 25 to 40 inches

Major Uses

Cropland, wildlife habitat

Major Management Factors
Soil-related factors: Permeability, wetness, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 48 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 245 days

Cropland
General management considerations.
Water tolerant plants can be grown.
Suitable crops for planting are grasses and legumes.
Wetness limits the period of grazing.
Drainage should be maintained throughout the growing season.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.
The content of soil moisture is optimum for tillage for only a short period.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Use open ditches or tile drains to remove water on or near the surface.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

24C-Heceta-Waldport fine sands, 0 to 15 percent slopes.

Composition
Heceta soil and similar inclusions - 50 percent
Waldport soil and similar inclusions - 35 percent
Contrasting inclusions - 15 percent

Heceta Soil
Position on landscape: Interdunal areas
Slope range: 0 to 3 percent
Elevation: 0 to 20 feet
Native plants: Willows, sedges, rushes
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 3 inches - very dark grayish brown fine sand
3 to 17 inches - grayish brown, mottled fine sand
17 to 60 inches - gray, mottled sand
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Permeability: Rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Depth to water table: October through May - 12 inches above the surface to 24 inches below the surface
Hazard of erosion: By water - slight; by wind - moderate

Waldport Soil

Position on landscape: Dunes
Slope range: 3 to 15 percent
Elevation: 10 to 30 feet
Native plants Shore pine, Sitka spruce, beachgrasses, Scotch-broom, salal
Typical profile:
0 to 5 inches - very dark brown and dark brown fine sand
5 to 15 inches - pale brown fine sand 1
5 to 60 inches - light brownish gray fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Permeability: Very rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion: By water - slight; by wind - severe

Included Areas

Soils that have a thin upper layer
Soils that have slopes of more than 15 percent

Major Uses

Wildlife habitat, wetland wildlife habitat in some areas

Major Management Factors
Soil-related factors: Wetness in some areas, inadequate drainage outlets in some areas, available water capacity in some areas, plant competition in some areas, erosion by wind in some areas
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 260 days

25D-Hemcross silt loam, 3 to 30 percent slopes.

Composition

Hemcross soil and similar inclusions - 75 percent
Contrasting inclusions - 25 percent

Hemcross Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, western swordfern, salal, red huckleberry, cascade Oregon-grape, western brackenfern
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 17 inches - dark brown silt loam
17 to 46 inches - brown and dark yellowish brown silt loam
46 to 60 inches - dark-yellowish brown very gravelly loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 8 to 11 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that have more than 35 percent coarse fragments between depths of 10 and 40 inches
Soils that are wet
Soils that have weathered siltstone at a depth of 40 to 60 inches
Soils that have basalt at a depth of 40 to 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Hazard of water erosion, susceptibility of upper layer to compaction, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 47 to 51 degrees F
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Douglas-fir - 172 (based on 100-year site curve); 134 (based on 50-year site curve)
Estimated total production per acre: 104,400 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 183 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Logging roads require suitable surfacing for year-round use.
Cutbanks occasionally slump when saturated.
Adequately designed road drainage reduces the risk of erosion.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

26E-Hemcross-Klistan complex, 30 to 60 percent slopes.

Composition
Hemcross soil and similar inclusions - 45 percent
Klistan soil and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Hemcross Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 200 to 1,600 feet

Native plants: Douglas-fir, western hemlock, red alder, vine maple; western swordfern, salal, cascade Oregon-grape, red huckleberry, western brackenfern
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 17 inches - dark brown silt loam
17 to 46 inches - brown and dark yellowish brown silt loam
46 to 60 inches - dark yellowish brown very gravelly loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 8 to 11 inches
Potential rooting depth: 60 inches or more
Runoff: Rapid
Hazard of erosion by water: Severe

Klistan Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, western swordfern, salal, cascade Oregon-grape, red huckleberry
Typical profile:
0 to 18 inches - dark brown gravelly loam and very gravelly loam
18 to 60 inches - dark yellowish brown very gravelly loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 9 inches
Potential rooting depth: 60 inches or more
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have basalt at a depth of less than 60 inches

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, gravel in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 47 to 51 degrees F
Frost-free period - 100 to 210 days

Woodland
Hemcross Soil
Mean site index for stated species: Douglas fir - 172 (based on 100-year site curve); 134 (based on 50-year site curve)
Estimated total production per acre: 104,400 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 183 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Klistan Soil
Mean site index-for stated species: Douglas-fir - 142 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 79,200 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 148 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Cutbanks occasionally slump when saturated.
Adequately designed road drainage reduces the risk of erosion.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

27-Humitropepts, 25 to 60 percent slopes.

Composition
Humitropepts - 75 percent
Contrasting inclusions - 25 percent

Humitropepts
Position on landscape: Escarpments
Slope range: 25 to 60 percent
Elevation: 10 to 300 feet
Native plants: Sitka spruce, western hemlock, Douglas-fir, red alder, vine maple, salmonberry, red elderberry, red huckleberry, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Reference profile:
0 to 17 inches - very dark brown silt loam and very dark grayish brown gravelly silt loam
17 to 36 inches - dark yellowish brown extremely gravelly loam and extremely gravelly clay loam
36 inches - weathered siltstone
Depth class: Moderately deep to very deep (20 inches or more)
Drainage class: Somewhat poorly drained to well drained
Permeability: Moderate
Available water capacity: 2 to 10 inches
Potential rooting depth: 20 inches or more
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than *25* percent or more than 60 percent
Soils that are wet
Rock outcroppings

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope in some areas, erosion by water, depth to bedrock in some areas, gravel and cobbles in some areas, rooting depth in some areas, available water capacity in some areas
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 245 days

Woodland
Site index and yields: Not estimated.
General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface in some areas.
Susceptibility of cut and fill areas to erosion is moderate to high.
Cutbanks occasionally slump when saturated.
Rilling and gullying can occur if the soil is used for yarding and skid trails, if firebreaks are constructed, or if the surface is otherwise disturbed.
Trees are subject to windthrow when the soil is excessively wet and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but floes not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

28-Humitropepts-Tropaquepts complex, 0 to 20 percent slopes.

Composition
Humitropepts - 45 percent
Tropaquepts - 40 percent
Contrasting inclusions - 15 percent

Humitropepts

Position on landscape: Terraces
Slope range: 0 to 20 percent
Elevation: 25 to 500 feet
Native plants: Sitka spruce, western hemlock, red alder, salmonberry, red huckleberry, trailing blackberry, swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Reference profile:
0 to 17 inches - very dark brown and very dark grayish brown silt loam
17 to 44 inches - dark yellowish brown silt loam and loam
44 to 60 inches - dark yellowish brown very gravelly loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained to moderately well drained
Permeability: Moderate
Available water capacity: 6 to 12 inches
Potential rooting depth: 25 to 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Tropaquepts

Position on landscape: Terraces
Slope range: 0 to 20 percent
Elevation: 25 to 500 feet
Native plants: Sitka spruce, western hemlock, sedges, rushes, grasses, salmonberry, western swordfern
Reference profile:
0 to 11 inches - very dark brown and very dark grayish brown silt loam
11 to 21 inches - grayish brown, mottled silt loam
21 to 54 inches - light brownish gray, mottled silty clay loam
54 to 60 inches - dark bluish gray, mottled silty clay loam
Depth class: Very deep (60 inches or more)
Drainage class: Somewhat poorly drained to poorly drained
Permeability: Moderately slow to slow
Available water capacity: 8 to 12 inches
Potential rooting depth: 25 to 60 inches or more for water tolerant plants
Runoff: Slow to medium
Hazard of erosion by water: Moderate
Depth to water table: 6 to 24 inches

Included Areas

Soils that have slopes of more than *20* percent

Soils that are clayey throughout the profile

Major Uses
Wildlife habitat, woodland

Major Management Factors
Soil-related factors: Gravel and cobbles in some areas, wetness in some areas, available water capacity in some areas, rooting depth in some areas, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 245 days

Woodland
Site index and yields: Not estimated.
General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Logging roads require suitable surfacing for year-round use.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Trees suitable for planting include western hemlock and Sitka spruce.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil and installing water bars and culverts.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.

29F-Kilchis-Rock outcrop complex, 60 to 90 percent slopes.

Composition
Kilchis soil and similar inclusions - 45 percent
Rock outcrop - 35 percent
Contrasting inclusions - 20 percent

Kilchis Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, salmonberry, red huckleberry, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 10 inches - dark brown very gravelly loam
10 to 18 inches - dark brown extremely cobbly loam
18 inches - fractured basalt
Depth class: Shallow (10 to *20* inches)
Drainage class: Well drained
Permeability. Moderately rapid
Available water capacity: 1 to 3 inches
Potential rooting depth: 10 to 20 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Rock Outcrop

Kind of rock: Basalt

Included Areas

Soils that have slopes of less than 60 percent or more than 90 percent
Soils that have bedrock at a depth of more than 20 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, depth to bedrock, rock outcroppings, rooting depth, gravel and cobbles, available water capacity
Climatic factors (mean annual):
Precipitation - 60 to 90 inches Soil temperature - 47 to 51 degrees F
Frost-free period - 100 to 210 days

Woodland
Kilchis Soil
Mean site index for stated species: Douglas-fir - 119 (based on 100-year site curve); 90 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 113 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 62,460 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 90 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Logging roads require suitable surfacing for year-round use.
Rock outcrop causes breakage of timber and hinders yarding.
The areas of Rock outcrop in this unit limit yield.
Trees are subject to windthrow because of the limited rooting depth.
Windthrow is a hazard when the soil is saturated and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
The limited available water capacity increases seedling mortality.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce, the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Manage regeneration carefully to reduce the competition of less desirable plants and provide shade for seedlings.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

30A-Kirkendall silt loam, 0 to 3 percent slopes.

Composition

Kirkendall soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Kirkendall Soil

Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 250 to 500 feet
Native plants: Douglas-fir, western hemlock, red alder, bigleaf maple, salal, vine maple, western swordfern, western brackenfern
Typical profile:
0 to 16 inches - very dark grayish brown and dark brown silt loam
16 to 41 inches - dark yellowish brown silt loam
41 to 60 inches - yellowish brown loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: More than 60 inches
Runoff: Slow
Hazard of erosion by water: Slight
Frequency of flooding. November through April - occasional
Depth to water table: November through April - 48 to *72* inches

Included Areas

Soils that are sandy throughout the profile
Soils that are wet

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Flooding, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland

General management considerations:
Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Seasonal flooding limits the period of time when crops can be established.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Seed only the hay and pasture plants that tolerate periodic inundation and seasonal wetness.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, planting early in spring to provide adequate cover in winter, providing structures or plant cover along streambanks, and removing large trees that may tip over along streambanks.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

31E-Klistan-Harslow complex, 30 to 60 percent slopes.

Composition

Klistan soil and similar inclusions - 45 percent
Harslow soil and similar inclusions - 30 percent
Contrasting inclusions - 25 percent

Klistan Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, western swordfern, salal, salmonberry, cascade Oregon-grape
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 18 inches - dark brown gravelly loam and very gravelly loam
18 to 60 inches - dark yellowish brown very gravelly loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 9 inches
Potential rooting depth: 60 inches or more
Runoff: Rapid
Hazard of erosion by water: Severe

Harslow Soil

Position on landscape: Mountainsides

Slope range: 30 to 60 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, salal, vine maple, red huckleberry, western swordfern, cascade Oregon-grape
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 18 inches - dark brown very gravelly loam
18 to 24 inches - brown very cobbly loam
24 to 34 inches - brown extremely gravelly loam
34 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have basalt at a depth of less than 20 inches
Soils that have slopes of less than 30 percent or more than 60 percent
Rock outcroppings
Soils that have less than 35 percent rock fragments throughout the profile

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, gravel, cobbles in some areas, water erosion; depth to bedrock in some areas; available water capacity in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 47 to 51 degrees F
Frost-free period - 100 to 210 days

Woodland
Klistan Soil
Mean site index for stated species: Douglas-fir - 142 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 79,200 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 148 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Harslow Soil
Mean site index for stated species: Douglas-fir - 135 (based on 100-year site curve); 98 (based on 50-year site curve)
Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations.
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Because roots are restricted by bedrock in the Harslow soil, trees commonly are subject to windthrow.
The limited available water capacity of the Harslow soil increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the, risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Manage regeneration carefully to reduce the competition of less desirable plants and provide shade for seedlings on the Harslow soil.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

31F-Klistan-Harslow complex, 60 to 90 percent slopes.

Composition
Klistan soil and similar inclusions - 40 percent
Harslow soil and similar inclusions - 35 percent
Contrasting inclusions - 25 percent

Klistan Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, western swordfern, salal, salmonberry, cascade Oregon-grape
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 18 inches - dark brown gravelly loam and very gravelly loam
18 to 60 inches - dark yellowish brown very gravelly loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 9 inches
Potential rooting depth: 60 inches or more
Runoff: Very rapid
Hazard of erosion by water: Severe

Harslow Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, salal, vine maple, red huckleberry, western swordfern, cascade Oregon-grape
Typical profile:
0 to 18 inches - dark brown very gravelly loam
18 to 24 inches - brown very cobbly loam
24 to 34 inches - brown extremely gravelly loam
4 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 60 percent or more than 90 percent
Soils that have basalt at a depth of less than 20 inches
Rock outcroppings

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, gravel, cobbles in some areas, depth to bedrock in some areas, available water in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 47 to 51 degrees F
Frost-free period - 100 to 210 days

Woodland
Klistan Soil
Mean site index for stated species: Douglas-fir - 142 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 79,200 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 148 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Harslow Soil
Mean site index for stated species: Douglas-fir - 135 (based on 100-year site curve); 98 (based on 50-year site curve)
Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Adequately designed road drainage reduces the risk of erosion.
Because roots are restricted by bedrock in the Harslow soil, trees commonly are subject to windthrow.
The limited available water capacity of the Harslow soil increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

32D-Klootchie silt loam, 3 to 30 percent slopes.

Composition
Klootchie soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Klootchie Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, western swordfern, red huckleberry, salal, salmonberry, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 12 inches - dark reddish brown silt loam
12 to 25 inches - reddish brown silt loam
25 to 43 inches - reddish brown gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have more than 35 percent rock fragments throughout the profile
Soils that have slopes of more than 30 percent
Soils that have weathered siltstone at a depth of 40 to 60 inches
Soils that are wet

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Susceptibility of the upper layer to compaction, erosion by water, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Western hemlock - 160 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 111,020 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 254 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 156 (based on 100-year site curve); 119 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 162 (based on 100-year site curve)

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Cutbanks occasionally slump when saturated.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is moderate.
Adequately designed road drainage reduces the risk of erosion.

Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads; cutbanks, and landings and installing water bars and culverts.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

33E-Klootchie-Necanicum complex, 30 to 60 percent slopes.

Composition
Klootchie soil and similar inclusions - 50 percent
Necanicum soil and similar inclusions - 30 percent
Contrasting inclusions - 20 percent

Klootchie Soil

Position on landscape: Mountainsides
Elevation: 100 to 1,600 feet
Slope range: 30 to 60 percent
Native plants: Western hemlock, Sitka spruce; Douglas-fir, red alder, western swordfern, red huckleberry, salal, salmonberry, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 12 inches - dark reddish brown silt loam
12 to 25 inches - reddish brown silt loam
25 to 43 inches - reddish brown gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Necanicum Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salal, western swordfern, salmonberry, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 12 inches - dark reddish brown gravelly loam and very gravelly loam
12 to 35 inches - dark brown and dark yellowish brown very gravelly loam
35 to 48 inches - yellowish brown extremely cobbly loam
48 inches - basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 8 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Contrasting included areas:
Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have hard basalt at a depth of less than 40 inches
Rock outcroppings
Soils that have weathered siltstone at a depth of less than 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, water erosion, gravel and cobbles in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies 9 degrees or less from summer to winter)
Frost-free period - 100 to 210 days

Woodland
Klootchie Soil

Mean site index for stated species: Western hemlock - 160 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 111,020 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 254 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 156 (based on 100-year site curve); 119 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 162 (based on 100-year site curve)

Necanicum Soil
Mean site index for stated species: Western hemlock - 133 (based on 100-year site curve); 97 (based on 50-year site curve)
Estimated total production per acre: 86,730 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 205 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 150 (based on 100-year site curve); 115 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 162 (based on 50-year site curve)

General management considerations:
Slope limits the kinds of equipment that can be used in forest management (fig. 5).
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.

Figure 5.-Areas of Klootchie-Necanicum complex, 30 to 60 percent slopes, on mountainsides.

Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn Leaves a greater number of rock fragments on the surface of the Necanicum soil.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Reforestation occurs naturally in cutover areas when a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

34D-Klootchie-Necanicum complex, 3 to 30 percent slopes, bouldery.

Klootchie soil and similar inclusions - 50 percent
Necanicum soil and similar inclusions - 30 percent
Contrasting inclusions - 20 percent

Klootchie Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, western swordfern, red huckleberry, salal, salmonberry, Oregon oxalis
Rock fragments on surface: Kind - boulders; percentage of surface covered - 0.1 to 3.0
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 12 inches - dark reddish brown silt loam
12 to 25 inches - reddish brown silt loam
25 to 43 inches - reddish brown gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Necanicum Soil

Position on landscape: Mountaintops
Slope range: 3 to *30* percent
Elevation: 100 to 1,600 feet
Native plants Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salmonberry; salal, western swordfern, Oregon oxalis
Rock fragments on surface: Kind - boulders; percentage of surface covered - 0.1 to 3.0
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 12 inches - dark reddish brown gravelly loam and very gravelly loam
12 to 35 inches - dark brown and dark yellowish brown very gravelly loam
35 to 48 inches - yellowish brown extremely cobbly loam 48 inches - basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas
Soils that have slopes of more than 30 percent
Soils that have weathered siltstone at a depth of 40 to 60 inches
Soils that are wet

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Boulders, gravel and cobbles in some areas, erosion by water, low amount of extractable phosphorus
Climatic factors (mean annual): Precipitation - 70 to 100 inches

Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland

Klootchie Soil
Mean site index for stated species: Western hemlock - 160 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 111,020 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 254 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 156 (based on 100-year site curve); 119 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 162 (based on 100-year site curve)
Necanicum Soil
Mean site index for stated species: Western hemlock - 133 (based on 100-year site curve); 97 (based on 50-year site curve)
Estimated total production per acre: 86,730 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 205 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 150 (based on 100-year site curve); 104 (based on 50-year site curve)
Mean site index for stated species Sitka spruce - 162 (based on 100-year site curve)

General management considerations
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Logging roads require suitable surfacing for year-round use.
Cutbanks occasionally slump when saturated.
Boulders on the surface can interfere with felling, yarding, and other logging that involves the use of equipment.
Adequately designed road drainage reduces the risk of erosion.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

34E-Klootchle-Necanicum complex, 30 to 60 percent slopes, bouldery.

Composition
Klootchie soil and similar inclusions - 50 percent
Necanicum soil and similar inclusions - 30 percent
Contrasting inclusions - 20 percent

Klootchie Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, western swordfern, red huckleberry, salal, salmonberry; Oregon oxalis
Rock fragments on surface: Kind - boulders; percentage of surface covered - 0.1 to 3.0
Organic mat on surface. Moss, needles; and twigs 2 inches thick
Typical profile.,
0 to 12 inches - dark reddish brown silt loam
12 to 25 inches - reddish brown silt loam
25 to 43 inches - reddish brown gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate

Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Necanicum Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salmonberry, salal, western swordfern, Oregon oxalis
Rock fragments on surface: Kind - boulders; percentage of surface covered - 0.1 to 3.0
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 12 inches - dark reddish brown gravelly loam and very gravelly loam
12 to 35 inches - dark brown and dark yellowish brown very gravelly loam
35 to 48 inches - yellowish brown extremely cobbly loam
48 inches - basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have weathered siltstone at a depth of less than 60 inches
Soils that have basalt at a depth of less than 40 inches
Rock outcroppings

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Boulders, gravel and cobbles in some areas, slope, erosion by water, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland

Klootchie Soil
Mean site index for stated species: Western hemlock - 160 (based on 100-year site curve); 113 (based on 50-year site curve)
Estimated total production per acre: 111,020 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 254 cubic feet per acre in a stand of, 50-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 156 (based on 100-year site curve); 119 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 162 (based on 100-year site curve)
Necanicum Soil
Mean site index for stated species: Western hemlock - 133 (based on 100-year site curve); 97 (based on 50-year site curve)
Estimated total production per acre: 86,730 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 205 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year--round use.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
Boulders on the surface can interfere with felling, yarding, and other logging that involves the use of equipment.
The waste material from roadbuilding can damage downslope vegetation. It is also a potential source of sedimentation.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:

Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.

Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

35B-Knappa silt loam, 0 to 7 percent slopes.

Composition

Knappa soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Knappa Soil

Position on landscape: Terraces
Slope range: 0 to 7 percent
Elevation: 100 to 350 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salmonberry, salal, red huckleberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:

0 to 23 inches - very dark brown,, very dark grayish brown, and dark brown silt loam

23 to 60 inches - dark yellowish brown silty clay loam

Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 11 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight

Included Areas

Soils that are wet
Soils that are loamy or sandy between depths of 20 and 60 inches
Soils that have a higher content of clay throughout the profile
Soils that are gravelly or cobbly between depths of 20 and 60 inches

Major Uses

Cropland, homesites, woodland, wildlife habitat

Major Management Factors

Soil-related factors: Load supporting capacity, susceptibility of the upper layer to compaction
Climatic factors (mean annual):

Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 175 to 210 days

Cropland

General management considerations

Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes, respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive, runoff.

Suitable management practices: -

Maintain or, improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce compaction of the soil by returning crop residue to the soil and keeping tillage at a minimum.
Reduce the risk of erosion by seeding disturbed areas to native or tame pasture plants and planting in April to early in May or in August to provide adequate cover in winter.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Woodland

Mean site index for stated species: Western hemlock - 167 (based on 100-year site curve); 114 (based on 50-year site curve)
Estimated total production per acre: 116,620 board feet (International rule, one-fourth-inch kerf) from a stand of trees 70 years old

Growth at culmination of mean annual increment (CMAI): 268 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

- Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
- Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
- When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
- Adequately designed road drainage reduces the risk of erosion.
- Logging roads require suitable surfacing for year-round use.
- Spoil from excavations is subject to rill and gully erosion and to sloughing.
- Soil compaction increases if yarding and skid trails converge.
- Reforestation occurs naturally in cutover areas if a seed source is present.
- Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
- Carefully managed reforestation reduces competition from undesirable understory plants.
- Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices:

- Use conventional equipment in harvesting, but limit its use when the soil is wet.
- Reduce the risk of erosion by avoiding excessive disturbance of the soil; seeding roads, cutbanks, and landings; and installing water bars and culverts.
- To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
- Prepare the site carefully to control competing vegetation.
- Hand plant nursery stock to establish or improve a stand.
- Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development

General management considerations

- The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
- If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

- Design buildings and roads to offset the limited ability of the soil to support a load.
- Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
- Provide a stable base and an adequate wearing surface to improve trafficability of roads.
- Install culverts to carry seasonal runoff where roads cross natural drainageways.

35C-Knappa silt loam, 7 to 15 percent slopes.

Composition

Knappa soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Knappa Soil

Position on landscape: Terraces
Slope range: 7 to 15 percent
Elevation: 100 to 350 feet
Native plants: Sitka spruce, western hemlock, Douglas-fir, red alder, salmonberry, salal, red huckleberry, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:

- 0 to 23 inches - very dark brown, very dark grayish brown, and dark brown silt loam
- 23 to 60 inches - dark yellowish brown silty clay loam

Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 11 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

- Soils that have slopes of less than 7 percent or more than 15 percent
- Soils that are wet
- Soils that are gravelly or cobbly between depths of 20 and 60 inches
- Soils that are loamy or sandy between depths of 20 and 60 inches
- Soils that are more than 35 percent clay between depths of 10 and 60 inches

Major Uses
Cropland, woodland, homesites, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 175 to 210 days

Cropland
General management considerations:
Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce compaction of the soil by returning crop residue to the soil and keeping tillage at a minimum.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting in April to early in May or in August to provide adequate cover in winter.
Maintain the quality and quantity of forage by rotating grazing, mowing and clipping, discouraging selective grazing, .limiting grazing to drier periods, controlling weeds, and applying fertilizer annually.

Woodland
Mean site index for stated species: Western hemlock - 167 (based on 100-year site curve); 114 (based on 50-year site curve)
Estimated total production per acre: 116,620 board feet (International rule, one-fourth-inch kerf) from a stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 268 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use:
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Soil compaction increases if yarding and skid trails converge.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices:
Use conventional equipment in harvesting, but, limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development
General management considerations:
Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Design and construct buildings and access roads to compensate for the steepness of slope.

In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.

Preserve the existing ,plant cover during construction to reduce the risk of erosion.

Stockpile topsoil and use it to reclaim areas disturbed during construction.

Design buildings and roads to offset the limited ability of the soil to support a load.

Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.

Provide a stable base and an adequate wearing surface to improve trafficability of roads.

Install culverts to carry seasonal runoff where roads cross natural drainageways.

36C-Knappa Variant loam, 3 to 15 percent slopes.

Composition

Knappa soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Knappa Variant Soil

Position on landscape: Terraces
Slope range: 3 to 15 percent
Elevation: 125 to 350 feet
Native plants: Western hemlock, Sitka spruce, red alder, vine maple, salmonberry, salal, red huckleberry, western swordfern
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:

0 to 21 inches - very dark brown, dark brown, and dark reddish brown silt loam

21 to 45 inches - dark yellowish brown gravelly clay loam and gravelly loam

45 to 60 inches - dark yellowish brown extremely cobbly loam

Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 8 to 10 inches
Potential rooting depth: 40 to 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that are wet

Soils that are not gravelly or cobbly throughout the profile

Soils that have a higher content of clay throughout the profile

Soils that have slopes of more than *15* percent

Major Uses

Cropland, homesites, wildlife habitat

Major Management Factors

Soil-related factors: Slope, gravel and cobbles, susceptibility of the upper layer to compaction
Climatic factors (mean annual):

Precipitation - 70 to 100 inches

Soil temperature - 49 to *52* degrees F (varies less than 9 degrees from summer to winter)

Frost-free period - 175 to 210 days

Cropland

General management considerations:

Most climatically adapted crops can be grown.

Suitable crops for planting are grasses and legumes.

Grasses and legumes grow well if they are adequately fertilized.

Most crops respond to nitrogen, phosphorus, potassium, and lime.

Legumes respond to phosphorus and lime. Additions of potassium may also be needed.

Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.

Reduce compaction of the soil by returning crop residue to the soil and keeping tillage at a minimum.

Reduce the risk of erosion by seeding disturbed areas to native or tame pasture plants and planting in April to early in May or in August to provide adequate cover in winter.

Irrigate during the dry period in summer.

Irrigate carefully to prevent the development of a perched water table.

Regulate the application of irrigation water to control runoff and erosion.

Apply enough water to wet the root zone but not so much that it leaches plant nutrients.

Maintain the quality and quantity of forage by rotating grazing, discouraging selective grazing, limiting grazing to drier periods, controlling weeds, and fertilizing.

Building Site Development

General management considerations:

Excavation is hampered by the cobbles in the soil.

If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Design and construct buildings and access roads to compensate for the steepness of slope.

In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.

Design buildings and roads to offset the limited ability of the soil to support a load.

Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.

Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.

Provide a stable base and an adequate wearing surface to improve trafficability of roads.

Install culverts to carry seasonal runoff where roads cross natural drainageways.

Reduce the risk of erosion on steep cut and fill slopes by establishing a plant cover on them.

37F-Laderly-Caterl complex, 60 to 90 percent slopes.

Composition

Laderly soil and similar inclusions - 40 percent
Caterl soil and similar inclusions - 35 percent
Contrasting inclusions - 25 percent

Laderly Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry, salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 16 inches - very dark brown and dark brown very gravelly loam
16 to 21 inches - dark brown very gravelly loam
21 to 37 inches - dark brown extremely cobbly loam
37 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Caterl Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry,. salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Typical profile:
0 to 12 inches - dark brown gravelly silt loam
12 to 28 inches - brown gravelly loam
28 to 43 inches - brown extremely gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 60 percent or more than 90 percent
Soils that have basalt at a depth of less than 20 inches
Rock outcroppings

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, depth to bedrock in some areas, rooting depth in some areas, gravel and cobbles, available water capacity in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland

Laderly Soil
Mean site index for stated species: Douglas-fir - 135 (based on 100-year site curve); 111 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Caterl Soil

Mean site index for stated species: Douglas-fir - 145 (based on 100-year site curve); 115 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 152 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 82,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Adequately designed road drainage reduces the risk of erosion.
Rock for road construction is available in this unit.
Trees on the Laderly soil are subject to windthrow because of the limited rooting depth.
Trees are subject to windthrow when the soil is excessively, wet and winds are strong.
The limited available water capacity of the Laderly soil increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees..

38F-Laderly-Rock outcrop complex, 60 to 90 percent slopes.

Composition
Laderly soil and similar inclusions - 40 percent
Rock outcrop - 35 percent
Contrasting inclusions - 25 percent

Laderly Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, vine maple, red huckleberry, salmonberry, western swordfern, western brackenfern, cascade Oregon-grape, salal, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 16 inches - very dark brown and dark brown very gravelly loam
16 to 21 inches - dark brown very gravelly loam
21 to 37 inches - dark brown extremely cobbly loam
37 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Rock Outcrop

Kind of rock: Basalt

Included Areas

Soils that have slopes of less than 60 percent or more than 90 percent
Soils that have basalt at a depth of less than 20 inches
Soils that have basalt at a depth of 40 to *60* inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, depth to bedrock, rock outcroppings in some areas, rooting

depth, gravel and cobbles, available water capacity, low amount of extractable phosphorus

Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 inches

Woodland

Laderly Soil

Mean site index for stated species: Douglas-fir - 135 (based on 100-year site curve); 111 (based on 50-year site curve)

Growth at culmination of mean annual increment (CMAI): 138 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Estimated total production per acre: 72,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management (fig. 6).
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.

Figure 6.-Area of Laderly-Rock outcrop complex, 60 to 90 percent slopes, on Saddle Mountain.

Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Adequately designed road drainage reduces the risk of erosion.
Trees are subject to windthrow because of the limited rooting depth.
Trees are subject to windthrow when the soil is excessively wet and winds are strong.
The limited available water capacity increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.
Rock outcrop causes breakage of timber and hinders yarding.
The areas of Rock outcrop in this unit limit yield.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging-to the soil.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

39A-Locoda silt loam, 0 to 3 percent slopes.

Composition
Locoda soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Locoda Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 3 percent
Elevation: 5 to 10 feet
Native plants: Willow, rushes, sedges
Typical profile:
0 to 10 inches - very dark grayish brown and grayish brown, mottled silt loam
10 to *26* inches - gray, mottled silty clay loam
26 to *60* inches - gray silt loam
Depth class: Very deep (60 inches or more)
Drainage class: Very poorly drained
Permeability: Moderately slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more for water tolerant plants
*Runoff: P*onded
*Hazard of erosion by water: S*light
Frequency of flooding: January through December - frequent
Depth to water table: November through June - 12 inches above the surface to 12 inches below the surface

Included Areas
Soils that are poorly drained
Soils that are clayey in the upper 40 inches
Soils that are organic throughout the profile
Soils that have a sandy layer between depths of 20 and 60 inches

Major Uses
Wetland wildlife habitat

Major Management Factors
Soil-related factors: Flooding; plant competition
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 50 to *52* degrees F
Frost-free period - 165 to 210 days

40A-Locoda silt loam, protected, 0 to 3 percent slopes.

Composition
Locoda soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Locoda Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 3 percent
Elevation: 5 to 10 feet
Slope feature: Concave
Native plants: Willow, sedges, rushes
Typical profile:
0 to 10 inches - very dark grayish brown and grayish brown, mottled silt loam
10 to 26 inches - gray, mottled silty clay loam
26 to 60 inches - gray silt loam

Depth class: Very deep (60 inches or more)
Drainage class: Very poorly drained
Permeability: Moderately slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Frequency of flooding: Rare
Depth to apparent water table: November through May - 12 inches above the surface-to 12 inches below the surface

Included Areas

Soils that are poorly drained
Soils that are clayey in the upper 40 inches
Soils that are organic throughout the profile
Soils that have a sandy layer between depths of 20 and 60 inches

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Flooding, wetness, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 50 to 53 degrees F
Frost-free period - 165 to 210 days

Cropland

General management considerations:

Most climatically adapted crops can be grown if adequate drainage and protection from flooding are provided.
Suitable crops for planting are grasses and legumes.
Wetness limits the choice of plants, the period of grazing, and the production of deep-rooted drops and increases the risk of winterkill.
Drainage should be maintained throughout the growing season.
Providing drainage is difficult because most areas have poor outlets.
Most crops respond to nitrogen, phosphorus, potassium,. and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Either select plants that tolerate wetness or provide drainage.
Maintain water control structures to reduce the risk of flooding.
Lower the water table by installing a drainage system.
Use open ditches or tile drains to remove water on or near the surface.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

41D-Mayger silt loam, 3 to 30 percent slopes.

Composition

Mayger soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Mayger Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 500 to 1,200 feet
Native plants: Douglas-fir, western redcedar, western hemlock, bigleaf maple, red alder, cascade Oregon-grape, common snowberry, salmonberry, red huckleberry, salal, western swordfern, western brackenfern
Typical profile:
0 to 12 inches - black and very dark gray silt loam
12 to 29 inches - dark grayish brown and grayish brown, mottled silty clay loam
29 to 60 inches - grayish brown, mottled silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Permeability: Very slow
Available water capacity: 8 to 11 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate
Depth to perched water table: November through May - 18 to *36* inches

Included Areas

Soils that are moderately well drained or well drained
Soils that have slopes of more than 30 percent
Soils that have weathered siltstone at a depth of less than 60 inches
Soils that are less than 35 percent clay throughout the profile

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Erosion by water, wetness, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 51 degrees F
Frost-free period - 120 to 160 days

Woodland
Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 127 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Steep yarding paths, skid trails, and firebreaks are subject to filling and gullying. A plant cover or water bars are needed.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Trees are subject to windthrow when the soil is excessively wet and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

42D-McMille silt loam, 3 to 30 percent slopes.

Composition

McMille soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

McMille Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red huckleberry, western swordfern, salal, vine maple, salmonberry
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 14 inches - dark brown silt loam
14 to 42 inches - brown silt loam
42 to 56 inches - brown very fine sandy loam
56 inches - weathered sandstone
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 13 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have basalt at a depth of 40 to 60 inches
Soils that have slopes of more than 30 percent
Soils that have weathered sandstone or siltstone at a depth of less than 40 inches
Soils that have more than 35 percent rock fragments throughout the profile

Major Uses
Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Susceptibility of upper layer to compaction, erosion by water

Climatic factors (mean annual):

Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland

Mean site index for stated species: Douglas-fir - 151 (based on 100-year site curve); 124 (based on 50-year site curve)

Growth at culmination of mean annual increment (CMAI): 159 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Estimated total production per acre: 87,680 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:

Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.

Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.

When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Susceptibility of cut and fill areas to erosion is moderate.

Logging roads require suitable surfacing for year-round use.

Adequately designed road drainage reduces the risk of erosion.

Spoil from excavations is subject to rill and gully erosion and to sloughing.

Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.

Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.

Reduce the risk of erosion by seeding roads, cutbanks; and landings and installing water bars and culverts.

To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Help to ensure establishment and survival of seedlings by selecting adapted plants.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

42E-McMille silt loam, 30 to 60 percent slopes.

Composition

McMille soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

McMille soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red huckleberry, western swordfern, salal, vine maple, salmonberry
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:

0 to 14 inches - dark brown silt loam
14 to 42 inches - brown silt loam
42 to 56 inches - brown very fine sandy loam
56 inches - weathered sandstone

Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 13 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have basalt at a depth of 40 to 60 inches
Soils that have weathered sandstone or siltstone at a depth of less than 40 inches
Soils that have more than 35 percent rock fragments throughout the profile
Soils that have slopes of less than 30 percent or more than 60 percent

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland
Mean site index for stated species: Douglas-fir - 151 (based on 100-year site curve); 124 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 159 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 87,680 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Susceptibility of cut and fill areas to erosion is high.
Logging roads require suitable surfacing for year-round use.
Adequately designed road drainage reduces the risk of erosion.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices.
Use highlead or other. logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

43A-McNulty silt loam, 0 to 3 percent slopes.

Composition

McNulty soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

McNulty Soil

Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 250 to 500 feet
Native plants: Bigleaf maple, red alder, vine maple, red huckleberry, western swordfern, western brackenfern, salal
Typical profile:
0 to 9 inches - dark brown silt loam
9 to 40 inches - dark yellowish brown loam and dark brown fine sandy loam
40 to 60 inches - dark brown sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight
Frequency of flooding: November through April - frequent

Included Areas
Soils that are wet
Soils that are moderately well drained
Soils that are gravelly and cobbly throughout the profile
Soils that are finer textured in the upper 40 inches

Major Uses
Cropland, wildlife habitat

Major Management Factors
Soil-related factors: Flooding, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland

General management considerations:

Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Seasonal flooding limits the period of time when crops can be established.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Seed only the hay and pasture plants that tolerate periodic inundation and seasonal wetness.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, planting early in spring to provide adequate cover in winter, providing structures along streambanks to control the flow of water, and removing large trees that may tip over along streambanks.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

44E-Millicoma gravelly loam, 30 to 60 percent slopes.

Composition

Millicoma soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Millicoma Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 500 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red-alder, salmonberry, red huckleberry, western swordfern, vine maple, salal, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 4 inches thick
Typical profile:

0 to 15 inches - very dark brown and dark brown gravelly loam
15 to 32 inches - brown very gravelly loam
32 to 38 inches - strong brown extremely gravelly loam
38 inches - weathered siltstone

Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained .
Permeability: Moderate
Available water capacity: 5 to 8 inches
Potential rooting depth: 20 to 40 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have basalt at a depth of 40 to 60 inches
Soils that have weathered siltstone at a depth of 40 to 60 inches
Soils that have less than 35 percent rock fragments throughout the profile

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, rooting depth
Climatic factors (mean annual):

Precipitation - 70 to 100 inches
Soil temperature - 47 to 51 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 200 days

Woodland

Mean site index for stated species: Western hemlock - 152 (based on 100-year site curve); 107 (based on 50-year site curve)
Estimated total production per acre: 103,810 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 241 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage downslope vegetation. It is also a potential source of sedimentation.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Roads for year-round use require heavy base rock.

Trees are subject to windthrow because of the limited rooting depth.
Trees are subject to windthrow when the soil is excessively wet and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices.
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

45A-Mues silt loam, 0 to 3 percent slopes.

Composition
Mues soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Mues Soil
Position on landscape: Stream terraces
Slope range: 0 to 3 percent
Elevation: 25 to 500 feet
Native plants: Sitka spruce, western hemlock, red alder, salal, salmonberry, western swordfern, red huckleberry
Typical profile:
0 to 25 inches - very dark brown and dark brown silt loam
25 to 36 inches - brown, mottled silt loam
36 to 60 inches - pale brown and light yellowish brown, mottled very gravelly loam that is strongly consolidated Depth class: Very deep (more than 60 inches) Drainage class: Moderately well drained
Permeability. Very slow
Available water capacity. 6 to 11 inches
Potential rooting depth: 25 to 40 inches
Runoff.- Slow
Hazard of erosion by water. Slight
Depth to perched water table: November through May - 24 to 36 inches

Included Areas
Soils that do not have consolidated, gravelly material in the lower part
Soils that are wet Soils that have a thin, dark-colored upper layer
Soils that have more than 35 percent gravel throughout the profile

Major Uses
Cropland, homesites, wildlife habitat.

Major Management Factors
Soil-related factors: Wetness, permeability, susceptibility of the upper layer to compaction, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period. - 210 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown if adequate drainage is provided.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Use tile drains to reduce wetness if a suitable outlet is available.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting early in spring to provide adequate cover in winter.
Irrigate during the dry period in summer.
Irrigate carefully to prevent the development of a perched water table.

Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Building Site Development
General management considerations:
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
Septic tank absorption fields may function poorly because of limited permeability and seasonal wetness.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Reduce wetness by installing drain tile around footings.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations,. basements, and underground utilities.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.

46D-Murtip loam, 3 to 30 percent slopes.

Composition
Murtip soil and similar inclusions - 75 percent
Contrasting inclusions - 25 percent

Murtip Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red. huckleberry, cascade Oregon-grape, western swordfern, vine maple, salmonberry, western brackenfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 11 inches - very dark brown and dark brown loam
11 to 38 inches - dark brown and brown loam
38 to 54 inches - brown gravelly and very gravelly loam
54 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas
Soils that have slopes of more than 30 percent
Soils that have more than 35 percent rock fragments throughout the profile
Soils that are wet
Soils that have basalt at a depth of less than 40 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Water erosion, susceptibility of upper layer to compaction, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland
Mean site index for stated species: Douglas-fir - 152 (based on 100-year site curve); 111 (based on 50-year site curve)
Estimated total production per acre: 88,480 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 161 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Mean site index for stated species: Western hemlock - 136 (based on 100-year site curve); 96 (based on 50-year site curve)

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Logging roads require suitable surfacing for year-round use.
Cutbanks occasionally slump when saturated.
Adequately designed road drainage reduces the risk of erosion.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir and western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

47E-Murtip-Caterl complex, 30 to 60 percent slopes.

Composition
Murtip soil and similar inclusions - 45 percent
Caterl soil and similar inclusions - 35 percent
Contrasting inclusions - 20 percent

Murtip Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red huckleberry, cascade Oregon-grape, western swordfern, vine maple, salmonberry, western brackenfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 11 inches - very dark brown and dark brown loam
11 to 38 inches - dark brown and brown loam
38 to 54 inches - brown gravelly and very gravelly loam
54 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Caterl Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red huckleberry, vine maple, western swordfern, western brackenfern, cascade Oregon-grape, Oregon oxalis, salal; salmonberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 12 inches - dark brown gravelly silt loam
12 to 28 inches - brown gravelly loam
28 to 43 inches - brown extremely gravelly loam
43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have basalt at a depth of less than 40 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, water erosion, gravel in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland

Murtip Soil
Mean site index for stated species: Douglas-fir - 152 (based on 100-year site curve); 111 (based on 50-year site curve)
Estimated total production per acre: 88,480 board feet (international rule, one-eighth-inch kerf) from a fully stocked stand of trees *80* years old
Growth at culmination of mean annual increment (CMAI): 161 cubic feet per acre in a stand of 60-

year-old trees 1.5 inches or larger in diameter at breast height

Caterl Soil

Mean site index for stated species: Douglas-fir - 145 (based on 100-year site curve); 115 (based on 50-year site curve)

Estimated total production per acre: 82,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

Growth at culmination of mean annual increment (CMAI): 152 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.

Highlead logging is more efficient than most other methods and is less damaging to the soil surface.

Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface of the Caterl soil.

Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.

Logging roads require suitable surfacing for year-round use.

Rock for road construction is available in this unit.

Susceptibility of cut and fill areas to erosion is high.

Adequately designed road drainage reduces the risk of erosion.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.

Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:

Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.

Reduce the risk of erosion by seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.

Avoid excessive, damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Help to ensure establishment and survival of seedlings by selecting adapted plants.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting .of mature trees.

48E-Murtip-Caterl complex, 30 to 60 percent slopes, bouldery.

Composition

Murtip soil and similar inclusions - 45 percent
Caterl soil and similar inclusions - 30 percent
Contrasting inclusions - 25 percent

Murtip Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red huckleberry, cascade Oregon-grape, western swordfern, vine maple, salmonberry, western brackenfern, Oregon oxalis
Rock fragments on surface: Kind - boulders; percentage of surface covered - 0.1 to 3.0 ,
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 11 inches - very dark brown and dark brown loam
11 to 38 inches - dark brown and brown loam
38 to 54 inches - brown gravelly and very gravelly loam
54 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 9 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Caterl Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 1,600 to 2,800 feet
Native plants Douglas-fir, western hemlock, Pacific silver fir, noble fir, red huckleberry, vine maple, western swordfern, western brackenfern, cascade Oregon-grape, Oregon oxalis, salal
Rock fragments on surface: Kind - boulders; percentage of surface covered - 0.1 to 3.0
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 12 inches - dark brown gravelly silt loam
12 to 28 inches - strong brown gravelly loam
28 to 43 inches - brown extremely gravelly loam

43 inches - weathered basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have basalt at a depth of less than 40 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, water erosion, boulders, gravel in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland
Murtip Soil
Mean site index for stated species: Douglas-fir - 152 (based on 100-year site curve); 111 (based on 50-year site curve)
Estimated total production per acre: 88,480 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 161 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Caterl Soil
Mean site index for stated species: Douglas-fir - 145 (based on 100-year site curve); 115 (based on 50-year site curve)
Estimated total production per acre: 82,080 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 152 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface of the Caterl soil.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
Boulders on the surface cause breakage of timber and hinder yarding.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

49A-Natal silty clay loam, 0 to 3 percent slopes.

Composition
Natal soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Natal Soil

Position on landscape: Stream terraces
Native plants: Vine maple, willow, Douglas spirea, sedges, rushes, horsetail
Typical profile:
0 to 6 inches - very dark gray silty clay loam

6 to 16 inches - dark gray silty clay loam
16 to 47 inches - dark gray silty clay
47 to 60 inches - dark grayish brown silty clay
Depth class: Very deep (60 inches or more)
Drainage class: Poorly drained
Permeability: Slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 10 to 30 inches for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Depth to water table: November through June - 6 inches above the surface to 6 inches below the surface

Included Areas

Soils that are better drained
Soils that are less clayey throughout the profile

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Wetness, inadequate drainage outlets in some areas, permeability, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland

General management considerations:
Water tolerant plants can be grown.
Suitable crops for planting are grasses and legumes.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Wetness limits the choice of plants, the period of grazing, and the production of deep-rooted crops.
Drainage should be maintained throughout the growing season.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Use open ditches or tile drains to remove water on or near the surface.
Plant grasses and legumes in spring when the soil is dry enough to prepare the seedbed.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, fertilizing, and installing drainage.

50E-Necanicum-Ascar complex, 30 to 60 percent slopes.

Composition

Necanicum soil and similar inclusions - 45 percent
Ascar soil and similar inclusions - 30 percent
Contrasting inclusions - 25 percent

Necanicum Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salmonberry, western swordfern, salal
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 12 inches - dark reddish brown gravelly loam and very gravelly loam
12 to 35 inches - dark brown and dark yellowish brown very gravelly loam
35 to 48 inches yellowish brown extremely cobbly loam
48 inches - basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Ascar Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, vine maple, red huckleberry, salmonberry; western swordfern, salal
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 35 inches - dark reddish brown extremely gravelly loam
35 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 2 to 4 inches
Potential rooting depth: 20 to 40 inches
Runoff: Rapid

Hazard of erosion by water: Severe

Included Areas

Soils that have less than 35 percent rock fragments throughout the profile
Soils that have weathered basalt at a depth of 40 to 60 inches
Soils that have basalt at a depth of less than 20 inches
Rock outcroppings

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Gravel and cobbles, depth to bedrock in some areas, slope, rooting depth in some areas, water erosion, available water capacity in some areas, low amount of extractable phosphorus
Climatic factors (average annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland

Necanicum Soil
Mean site index for stated species: Western hemlock - 133 based on 100-year site curve; 97 (based on 50-year site curve)
Estimated total production per acre: 86,730 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 205 cubic feet per acre in a stand of 50-year-old trees 1.5 inches in diameter at breast height
Ascar Soil
Mean site index for stated species: Western hemlock - 145 (based on 100-year site curve); 103 (based on 50-year site curve)
Estimated total production per acre: 97,510 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 228 cubic feet per acre in a stand of 50-year-old trees 1.5 inches in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Susceptibility of cut and fill areas to erosion is high.
The waste material from roadbuilding can damage downslope vegetation. It is also a potential source of sedimentation.
Roads for year-round use require heavy base rock.
Rock for road construction is available in this unit.
Windthrow is a hazard on the Ascar soil when it is saturated and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
The limited available water capacity of the Ascar soil increases seedling mortality.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Manage regeneration carefully to reduce the competition of less desirable plants and provide shade for seedlings on the Ascar soil.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

50F-Necanicum-Ascar complex, 60 to 90 percent slopes.

Composition

Necanicum soil and similar inclusions - 40 percent
Ascar soil and similar inclusions - 35 percent
Contrasting inclusions - 25 percent

Necanicum Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent

Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, western swordfern, salal, salmonberry
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 12 inches - dark reddish brown gravelly loam and very gravelly loam
12 to 35 inches - dark brown and dark yellowish brown very gravelly loam
35 to 48 inches - yellowish brown extremely cobbly loam
48 inches - basalt
Depth class: Deep (40 to 60 inches) '
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 8 inches
Potential rooting depth: 40 to 60 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Ascar Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, vine maple, red huckleberry, salmonberry, salal, western swordfern
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical profile:
0 to 35 inches - dark reddish brown extremely gravelly loam
35 inches - basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability. Moderately rapid
Available water capacity: 2 to 4 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas

Rock outcroppings
Soils that have basalt at a depth of less than 20 inches
Soils that have slopes of less than 60 percent or more than 90 percent

Major Uses

Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, depth to bedrock in some areas, rooting depth in some areas, gravel and cobbles, available water capacity in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland
Necanicum Soil
Mean site index for stated species: Western hemlock - 133 (based on 100-year site curve); 97 (based on 50-year site curve)
Estimated total production per acre: 86,730 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 205 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at . breast height
Ascar Soil
Mean site index for stated species: Western hemlock - 145 (based on 100-year site curve); 103 (based on 50-year site curve)
Estimated total production per acre: 97,510 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 228 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Windthrow is a hazard on the Ascar soil when it is saturated and winds are strong.
Reforestation occurs naturally in cutover areas if a seed source is present.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
The limited available water capacity of the Ascar soil increases seedling mortality.
Carefully managed reforestation reduces plant competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid, excessive damage to the soil and to the vegetation downslope from roadbuilding sites by , removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Manage regeneration carefully to reduce the competition of less desirable plants and provide shade for seedlings on the Ascar soil.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

51A-Nehalem silt loam, 0 to 3 percent slopes.

Composition
Nehalem soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Nehalem Soil
Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 15 to 300 feet
Native plants: Sitka spruce, western hemlock, red alder, salmonberry
Typical profile.
0 to 14 inches - dark brown silt loam
14 to 48 inches - dark yellowish brown silt loam
48 to 60 inches - brown silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight
Frequency of flooding: November through April - occasional
Depth to water table: 48 to 72 inches

Included Areas

Soils that are wet
Soils that are gravelly and cobbly throughout the profile
Soils that are, finer textured throughout the profile
Soils that are sandy throughout the profile
Soils that are not flooded

Major Uses
Cropland, wildlife habitat

Major Management Factors
Soil-related factors: Flooding, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Seasonal flooding limits the period of time when crops can be established.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus. and lime. Additions of potassium may be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Seed only the hay and pasture plants that tolerate periodic inundation and seasonal wetness.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, planting early in spring to provide adequate cover in winter, providing structures along streambanks to control the flow of water, and removing large trees that may tip over along streambanks.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods,

mowing and clipping, controlling weeds, and applying fertilizer annually.

52A-Nestucca silt loam, 0 to 3 percent slopes.

Composition

Nestucca soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Nestucca Soil

Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 15 to 300 feet
Native plants: Sitka spruce, red alder, sedges, rushes
Typical profile:
0 to 16 inches - dark brown silt loam
16 to 32 inches - dark grayish brown, mottled silt loam
32 to 60 inches - grayish brown, mottled silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Available water capacity: 11 to 14 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight
Depth to water table: November to May - 12 to 24 inches
Frequency of flooding: November through April - frequent

Included Areas

Soils that are poorly drained or very poorly drained
Soils that are well drained or moderately well drained
Soils that are gravelly and cobbly throughout the profile
Soils that are loamy or sandy in the upper 40 inches

Major Uses
Cropland, wildlife habitat

Major Management Factors
Soil-related factors: Flooding, wetness, permeability, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 180 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown if adequate drainage and protection from flooding are provided.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Seasonal flooding limits the period of time when crops can be established.
Wetness limits the choice of plants and increases the risk of winterkill.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices
Seed only the hay and pasture plants that tolerate periodic inundation and seasonal wetness.
Install subsurface drains or drainage ditches, or both.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation, water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Reduce the risk of erosion by providing structures along streambanks to control the flow of water, planting early in spring to provide adequate cover in winter, seeding disturbed areas to native or tame pasture plants, using minimum tillage, and removing large trees that may tip over along streambanks.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

53D-Newanna-gravelly loam, 3 to 30 percent slopes.

Composition
Newanna soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Newanna Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 2,800 to 3,200 feet

Native plants: Pacific silver fir, noble fir, Douglas-fir, western hemlock, mountain hemlock, red huckleberry, big huckleberry, salal, common beargrass, salmonberry, gooseberry

Typical profile:

0 to 12 inches - dark reddish brown gravelly loam
12 to 21 inches - dark reddish brown very cobbly loam
21 to 26 inches - strong brown very stony loam
26 inches - basalt

Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 3 to 6 inches
Potential rooting depth: 20 to 40 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have basalt at a depth of more than 40 inches
Soils that have less than 35 percent rock fragments throughout the profile
Soils that have weathered basalt or sedimentary bedrock at a depth of 20 to 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Erosion by water; depth to bedrock; gravel, cobbles, and stones; rooting depth; available water capacity; susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 41 to 45 degrees F
Frost-free period - 30 to 60 days

Woodland
Estimated mean site index: Western hemlock - 80 (based on 100-year site curve)
Estimated total production per acre: 43,000 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees
Growth at culmination of mean annual increment (CMAI): 99 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is moderate.
Adequately designed road drainage reduces the risk of erosion.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
Areas on ridgetops that are exposed to strong, persistent winds are less productive than other areas.
Trees are subject to windthrow because of the limited rooting depth.
Trees are subject to windthrow when the soil is excessively wet and winds are strong.
The limited available Water capacity increases seedling mortality.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting western hemlock, Pacific silver fir, or noble fir seedlings.

Suitable management practices:
Reduce the risk of erosion by avoiding excessive disturbance of the soil; seeding roads, cutbanks, and landings;. and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

54F-Newanna-Rock outcrop complex, 60 to 90 percent slopes.

Composition
Newanna soil and similar inclusions - 45 percent
Rock outcrop - 35 percent
Contrasting inclusions - 20 percent

Newanna Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 2,800 to 3,200 feet
Native plants: Pacific silver fir, noble fir, Douglas-fir, western hemlock, mountain hemlock, red huckleberry, big huckleberry, salal, common beargrass, salmonberry, gooseberry
Typical profile:
0 to 12 inches - dark reddish brown gravelly loam
12 to 21 inches - dark reddish brown very cobbly loam
21 to 26 inches - strong brown very stony loam
26 inches - unweathered basalt
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 3 to 6 inches
Potential rooting depth: 20 to 40 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Rock Outcrop
Kind of rock: Basalt

Included Areas
Soils that have basalt at a depth of less than 20 inches or more than 40 inches
Soils that have slopes of less than 60 percent or more than 90 percent

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope; erosion by water; depth to bedrock; gravel, cobbles, and stones; rooting depth; available water capacity
Climatic factors (mean annual):
Precipitation - 80 to 100 inches
Soil temperature - 41 to 45 degrees F
Frost-free period - 30 to 60 days

Woodland
Estimated mean site index: Western hemlock - 80 (based on 100-year site curve)
Estimated total production per acre: 43,000 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees
Growth at culmination of mean annual increment (CMAI): 99 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Rock for road construction is available in this unit.
Susceptibility of cut and fill areas to erosion is high.
The areas of Rock outcrop in this unit limit yield.
Adequately designed road drainage reduces the risk of erosion.
Rock outcrop causes breakage of timber and hinders yarding.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Trees are subject to windthrow because of the limited rooting depth.
Windthrow is a hazard when the soil is saturated and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting western hemlock, Pacific silver fir, or noble fir seedlings.
The limited available water capacity increases seedling mortality.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

55B-Northrup silt loam, 0 to 7 percent slopes.

Composition

Northrup soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Northrup Soil

Position on landscape: Terraces
Slope range: 0 to 7 percent
Elevation: 400 to 600 feet
Native plants: Douglas-fir, western hemlock, bigleaf maple, red alder, vine maple, western swordfern, salal, red huckleberry
Typical profile:
0 to 18 inches - very dark grayish brown and dark brown silt loam
18 to 24 inches - yellowish brown, mottled silty clay loam
24 to 60 inches - pale brown and light yellowish brown, mottled silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Available water capacity: 10 to 14 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Depth to perched water table: November through April - 12 to 36 inches
Hazard of erosion by water: Slight

Included Areas

Soils that have slopes of more than 7 percent
Soils that are moderately well drained or well drained
Soils that are finer textured throughout the profile
Soils that are poorly drained or very poorly drained

Major Uses

Cropland, homesites, woodland, wildlife habitat

Major Management Factors

Soil-related factors: Permeability, wetness, load supporting capacity, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland
General management considerations:
Water tolerant plants can be grown.
Most climatically adapted crops can be grown if adequate drainage is provided.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Select plants that tolerate wetness or provide drainage.
Use tile drains to intercept runoff from higher lying areas.
Install subsurface drains or drainage ditches, or both.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting early in spring to provide adequate cover in winter.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Woodland
Estimated site index for stated species: Douglas-fir - 160 (based on 100-year site curve)
Estimated total production per acre: 95,200 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old
Estimated growth at culmination of mean annual increment (CMAI): 170 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.

Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Soil compaction increases if yarding and skid trails converge.
Trees are subject to windthrow because of the limited rooting depth.
Windthrow is a hazard when the soil is saturated and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil; seeding roads, cutbanks, and landings; and installing water bars and culverts.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development

General management considerations:
Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Reduce wetness by providing suitably designed drainage ditches and installing drain tile around footings.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.

55C-Northrup silt loam, 7 to 15 percent slopes.

Composition

Northrup soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Northrup Soil

Position on landscape: Terraces
Slope range: 7 to 15 percent
Elevation: 400 to 600 feet
Native plants: Douglas-fir, western hemlock, bigleaf maple, red alder, vine maple, western swordfern, salal, red huckleberry
Typical profile:
0 to 18 inches - very dark grayish brown and dark brown silt loam
18 to 24 inches - yellowish brown, mottled silty clay loam
24 to 60 inches - pale brown and light yellowish brown, mottled silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Available water capacity: 10 to 14 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Depth to perched water table: November through May - 12 to -36 inches
Hazard of erosion by water: Moderate

Included Areas

Contrasting included areas:
Soils that have slopes of less than 7 percent or more than 15 percent
Soils that are moderately well drained or well drained
Soils that are finer textured throughout the profile

Major Uses
Cropland, homesites, woodland, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, permeability, wetness, load supporting capacity, susceptibility of upper layer to compaction

Climatic factors (mean annual):

Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland

General management considerations:

Water tolerant plants can be grown.
Most climatically adapted crops can be grown if adequate drainage is provided.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Select plants that tolerate wetness or provide drainage.
Use tile drains to intercept runoff from higher lying areas.
Install subsurface drains or drainage ditches, or both.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures..
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, planting early in spring or by mid-August to provide adequate cover in winter, and tilling on the contour or across the slope.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; limiting grazing to drier periods; mowing and clipping; controlling weeds; and applying fertilizer annually.

Woodland

Estimated site index for stated species: Douglas-fir - 160 (based on 100-year site curve)

Estimated total production per acre: 95,200 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old

Estimated growth at culmination of mean annual increment (CMAI): 170 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:

Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Maintaining the understory vegetation is essential in controlling erosion.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Soil compaction increases if yarding and skid trails converge.
Trees are subject to windthrow because of the limited rooting depth.
Windthrow is a hazard when the soil is saturated and winds are strong.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.

Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development
General management considerations:
Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Reduce wetness by providing suitably designed drainage ditches and installing drain tile around footings.
In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Increase the size of the septic tank absorption field to compensate for the restricted permeability.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Reduce the risk of erosion on steep cut and fill slopes by establishing a plant cover on them.
Install culverts to carry seasonal runoff where roads cross natural drainageways.

56D-Rinearson silt loam, 3 to 30 percent slopes:

Composition
Rinearson soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Rinearson Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 500 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, bigleaf maple, vine maple, western swordfern; salal, cascade Oregon-grape, red huckleberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 15 inches - very dark brown silt loam
15 to 34 inches - dark yellowish brown and dark brown silty clay loam
34 to 48 inches - yellowish brown loam
48 inches - weathered siltstone
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 8 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas
Soils that have slopes of more than 30 percent
Soils that are poorly drained
Soils that are finer textured throughout the profile
Soils that are fine-loamy or coarse-loamy between depths of 10 and 40 inches
Soils that have an upper layer that is more than 20 inches thick

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Erosion by water, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Douglas-fir - 165 (based on 100-year site curve); 132 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 176 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 99,040 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.

When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Susceptibility of cut and fill areas to erosion is moderate.
Logging roads require suitable surfacing for year-round use.
Adequately designed road drainage reduces the risk of erosion.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

56E-Rinearson silt loam, 30 to 60 percent slopes.

Composition
Rinearson soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Rinearson Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 500 to 1,600 feet
Native plants Douglas-fir, western hemlock, red alder, bigleaf maple, vine maple, western swordfern, salal, cascade Oregon-grape, red huckleberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 15 inches - very dark brown silt loam
15 to 34 inches - dark yellowish brown and dark brown silty clay loam
34 to 48 inches - yellowish brown loam
48 inches - weathered siltstone
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 8 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 30 percent or more than 60 percent
Soils that have basalt at a depth of 40 to 60 inches
Soils that are finer textured throughout the profile
Soils that are fine-loamy or coarse-loamy between depths of 10 and 40 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Douglas-fir - 165 (based on 100-year site curve); 132 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 176 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 99,040 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.

Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural of artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

56F-Rinearson silt loam, 60 to 90 percent slopes.

Composition

Rinearson soil and similar inclusions - 75 percent
Contrasting inclusions - 25 percent

Rinearson Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 500 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, bigleaf maple, vine maple, western swordfern, salal, cascade Oregon-grape, red huckleberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical *profile:*
0 to 15 inches - very dark brown silt loam
15 to 34 inches - dark yellowish brown and dark brown silty clay loam
34 to 48 inches - yellowish brown loam
48 inches - weathered siltstone

Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 8 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 60 percent or more than 90 percent
Rock outcroppings
Soils that have weathered siltstone at a depth of less than 40 inches
Soils that have basalt at a depth of 20 to 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water
Climatic factors (mean annual):
Precipitation - 60 to 90 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Douglas-fir - 165 (based on 100-year site curve); 132 (based on 50-year site curve)
Growth at culmination of mean annual increment. (CMAI): 176 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 99,040 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
Spoil from excavations is subject to rill and gully erosion and to sloughing.

The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stack to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

57E-Scaponia-Braun silt loams, 30 to 60 percent slopes.

Composition
Scaponia soil and similar inclusions - 50 percent
Braun soil and similar inclusions - 35 percent
Contrasting inclusions - 15 percent

Scaponia Soil
Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, western redcedar, vine maple, cascade Oregon-grape, red huckleberry, salal, creambush oceanspray
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 7 inches - very dark grayish brown silt loam
7 to 43 inches - dark yellowish brown and yellowish brown silt loam
43 inches - weathered siltstone
Depth class: Moderately deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 12 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Braun Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 200 to 1,600 feet
Native plants: Douglas-fir, western redcedar, bigleaf maple, red alder, vine maple, cascade Oregon-grape, creambush oceanspray, red huckleberry, salal, western swordfern
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 3 inches - very dark grayish brown silt loam
3 to 20 inches - dark yellowish brown and brown silt loam
20 to 35 inches - strong brown silt loam
35 inches - weathered siltstone
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 6 to 10 inches
Potential rooting depth: 20 to 40 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 30 percent or more than 60 percent
Soils that are gravelly or cobbly throughout the profile
Soils that have basalt- at a depth of less than 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Depth to bedrock in some areas, slope, erosion by water
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 47 to 52 degrees F
Frost-free period - 100 to 180 days

Woodland
Scaponia Soil
Mean site index for stated species: Douglas-fir - 173 (based on 100-year site curve); 133 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 184 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Estimated total production per acre: 105,200 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

Braun Soil

Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 129 (based on 50-year site curve)

Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.

Highlead logging is more efficient than most other methods and is less damaging to the soil surface.

When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Logging roads require suitable surfacing for year-round use.

Susceptibility of cut and fill areas to erosion is high.

Adequately designed road drainage reduces the risk of erosion.

Spoil from excavations is subject to rill and gully erosion and to sloughing.

The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.

The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Because roots are restricted by bedrock, trees on the Braun soil commonly are subject to windthrow.

Trees on the Braun soil are subject to windthrow because of the limited rooting depth.

Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.

Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:

Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.

Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

58D-Skipanon gravelly silt loam, 3 to 30 percent slopes.

Composition

Skipanon soil and similar inclusions - 80 percent

Contrasting inclusions - 20 percent

Skipanon Soil

Position on landscape: Mountaintops

Slope range: 3 to 30 percent

Elevation: 100 to 1,600 feet

Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, western swordfern, salal, salmonberry, Oregon oxalis

Organic mat on surface: Moss, needles, and twigs 2 inches thick

Typical profile:

0 to 19 inches - dark brown gravelly silt loam

19 to 36 inches - brown cobbly silt loam

36 to 53 inches - variegated light yellowish brown and yellowish brown silty clay loam

53 inches - weathered siltstone

Depth class: Deep (40 to 60 inches)

Drainage class: Well drained

Permeability: Moderate

Available water capacity: 7 to 11 inches

Potential rooting depth: 40 to 60 inches

Runoff: Medium

Hazard of erosion by water: Moderate

Included Areas

Soils that have basalt at a depth of 40 to 60 inches

Soils that have more than 35 percent rock fragments throughout the profile

Soils that have less than 15 percent rock fragments throughout the profile

Soils that are wet

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Erosion by water, susceptibility of upper layer to compaction

Climatic factors(mean annual):

Precipitation - 70 to 100 inches

Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland

Mean site index for stated species: Western hemlock - 159 (based on 100-year site curve); 112 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 252 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 110,110 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old

General management considerations:

Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Susceptibility of cut and fill areas to erosion is moderate.
Adequately designed road drainage reduces the risk , of erosion.
Logging roads require suitable surfacing for year-round use.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:

Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

58E-Skipanon gravelly silt loam, 30 to 60 percent slopes.

Composition

Skipanon soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Skipanon Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, western swordfern, salal, salmonberry, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 2 inches thick
Typical *profile:*
0 to 19 inches - dark brown gravelly silt loam
19 to 36 inches - brown cobbly silt loam
36 to 53 inches - variegated, light yellowish brown and yellowish brown silty clay loam
53 inches - weathered siltstone
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 11 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have weathered siltstone at a depth of less than 40 inches
Soils that have basalt at a depth of 40 to 60 inches
Soils that have more than 35 percent rock fragments throughout the profile
Soils that have less than 15 percent rock fragments throughout the profile

Major Uses
Woodland, wildlife habitat (fig. 7)

Major Management Factors
Soil-related factors: Slope, erosion by water
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees, F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland
Mean site index for stated species: Western hemlock - 159 (based on 100-year site curve); 112 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 252 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 110,110 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old -

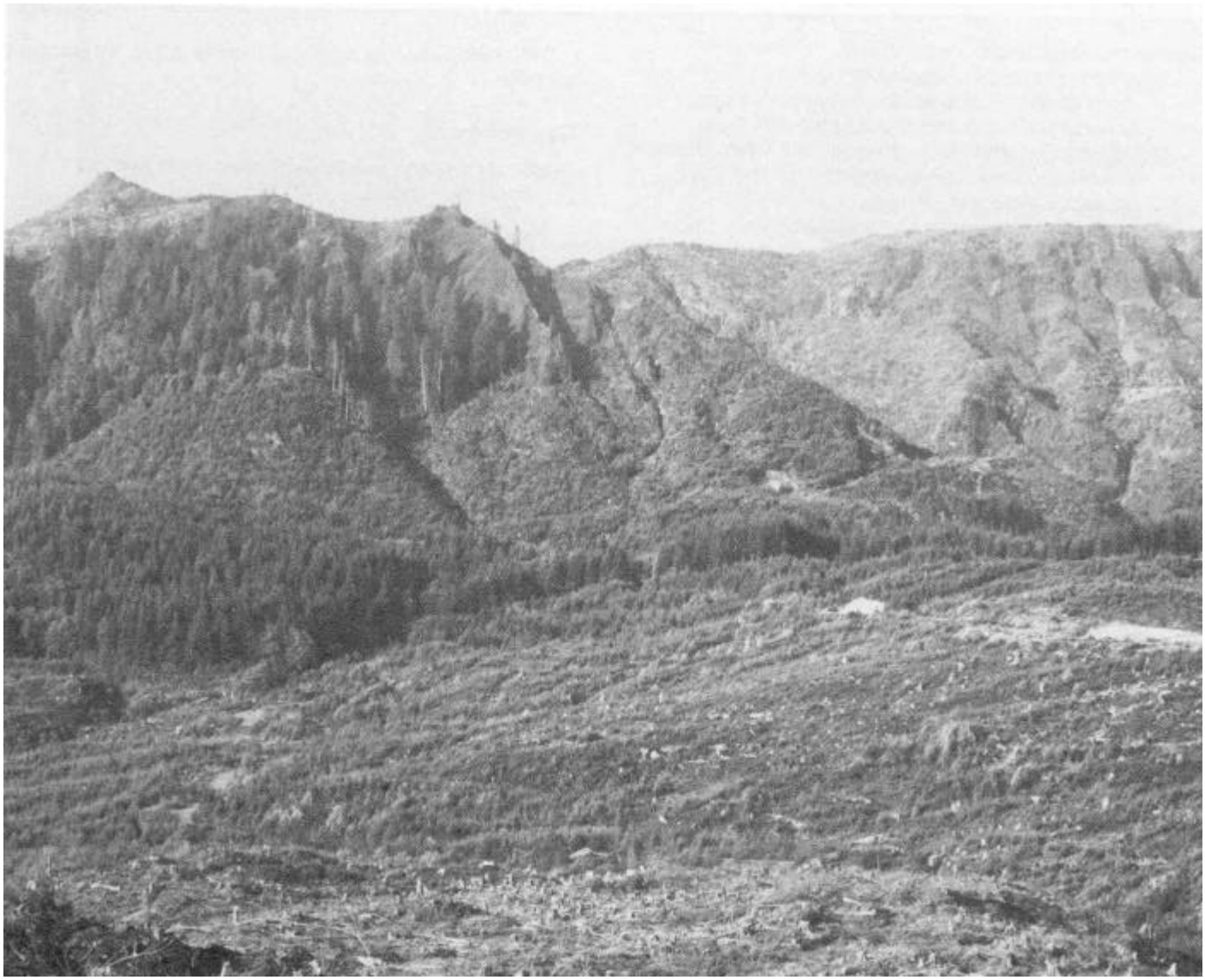

Figure 7.-Area of Skipanon gravelly silt loam, 30 to 60 percent slopes, in foreground.

General management considerations:

Slope limits the kinds of equipment that can be used in forest management.

Highlead logging is more efficient than most other methods and is less damaging to the soil surface.

Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface.

Constructing roads at midslope results, in large cuts and fills, which increases the risk of erosion.

Logging roads require suitable surfacing for year-round use.

Susceptibility of cut and fill areas to erosion is high.

Spoil from excavations is subject to rill and gully erosion and to sloughing.

The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.

Adequately designed road drainage reduces the risk of erosion.

The waste material from roadbuilding can damage. downslope vegetation. It is also a potential source of sedimentation.

Reforestation occurs naturally in cutover areas if a seed source is present.

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

Carefully managed reforestation reduces plant competition from undesirable understory plants.

Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:

Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.

Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.

Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.

Hand plant nursery stock to establish or improve a stand.

Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

59D-Svensen loam, 3 to 30 percent slopes.

Composition

Svensen soil and similar inclusions - 75 percent
Contrasting inclusions - 25 percent

Svensen Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 100 to 500 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salmonberry, salal, vine maple, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:

0 to 17 inches - very dark brown and dark brown loam
17 to 38 inches - brown loam
38 to 60 inches - variegated, strong brown and light brownish gray fine sandy loam

Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 11 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that are wet
Soils that have an upper layer that is In ore than 20 inches thick
Soils that are silt loam or silty clay loam throughout the profile
Soils that have weathered siltstone at a depth of 40 to 60 inches

Major Uses

Woodland, homesites, cropland, wildlife habitat

Major Management Factors

Soil-related factors: Erosion by water, susceptibility of the upper layer to compaction
Climatic factors (mean annual):

Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 175 to 245 days

Cropland

General management considerations.

Most climatically adapted crops can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.

Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.

Suitable management practices:
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by using minimum tillage.
Reduce the risk of erosion by using minimum tillage and seeding disturbed areas to native or tame pasture plants.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; discouraging selective grazing; limiting grazing to drier periods; controlling weeds; and applying fertilizer annually.

Woodland

Mean site index for stated species: Western hemlock - 158 (based on 100-year site curve); 117 (based on 50-year site curve)
Estimated total production per acre: 109,200 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or .larger in diameter at breast height
Mean site index for stated species: Douglas-fir - 160 (based on 100-year site curve); 118 (based on 50-year site curve)

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
When wet, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.
Susceptibility of cut and fill areas to erosion is high.
Cutbanks occasionally slump when saturated.
Adequately designed road drainage reduces the risk of erosion.
Logging roads require suitable surfacing for year-round use.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Trees suitable for planting include western hemlock, Sitka spruce, and Douglas-fir.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

Building Site Development

General management considerations:
Excavation increases the risk of water erosion.
Road cutbanks are subject to slumping.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Design and construct buildings and access roads to compensate for the steepness of slope.
In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.
Preserve the existing plant cover during construction to reduce the risk of erosion.
Stockpile topsoil and use it to reclaim areas disturbed during construction.
Design roads and streets to compensate for the instability of the soil.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for

foundations, basements, and underground utilities.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.
Reduce the risk of erosion on steep cut and fill slopes by establishing a plant cover on them.

59E-Svensen loam, 30 to 60 percent slopes.

Composition

Svensen soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Svensen Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 20 to 500 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salal, salmonberry, vine maple, western swordfern, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs *3* inches thick
Typical profile:
0 to 17 inches - very dark brown and dark brown loam
17 to 38 inches - brown loam
38 to 60 inches - variegated, strong brown and light brownish gray fine sandy loam
60 inches - soft bedrock
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 7 to 11 inches
Potential rooting depth: 60 inches or more
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have weathered siltstone or sandstone at a depth of less than 40 inches
Soils that are finer textured throughout the profile
Soils that have slopes of less than 30 percent or more than 60 percent

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to *53* degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 175 to 245 days

Woodland

Mean site index for stated species: Western hemlock - 166 (based on 100-year site curve); 117 (based on 50-year site curve).
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 115,780 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Mean site index for stated species: Douglas-fir - 160 (based on 100-year site curve); 118 (based on 50-year site curve)

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are *soft.* They may be impassable during rainy periods.
Susceptibility of cut and fill areas to erosion is high.
Adequately designed road drainage reduces the risk of erosion.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
The waste material from roadbuilding can damage downslope vegetation. It is also a potential source of sedimentation.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does riot prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

59F-Svensen loam, 60 to 90 percent slopes.

Composition
Svensen soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Svensen Soil

Position on landscape: Mountainsides
Slope range: 60 to 90 percent
Elevation: 20 to 500 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, red huckleberry, salal, salmonberry, vine maple, western swordfern
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:
0 to 17 inches - very dark brown and dark brown loam
17 to 38 inches - brown loam
38 to 60 inches - variegated, strong brown and light brownish gray fine sandy loam
60 inches - soft bedrock
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: 7 to 11 inches
Potential rooting depth: 60 inches or more
Runoff: Very rapid
Hazard of erosion by water: Severe

Included Areas
Soils that have slopes of less than 60 percent
Soils that have weathered sandstone at a depth of less than 40 inches
Rock outcroppings

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 175 to 245 days

Woodland
Mean site index for stated species: Western hemlock - 158 (based on 100-year site curve); 117 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 109,200 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Mean site index for stated species: Douglas-fir - 157 (based on 100-year site curve); 118 (based on 50-year site curve).

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is high (fig. 8).
Adequately designed road drainage reduces the risk of erosion.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion and removes land from production.
The waste material from roadbuilding can damage downslope vegetation. It is also a potential source of sedimentation.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutb4nks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.

Figure 8.-Roadbank failure in an area of Svensen loam, 60 to 90 percent slopes.

Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

60D-Templeton silt loam, 3 to 30 percent slopes.

Composition
Templeton soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Templeton Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salal, salmonberry, western swordfern, red huckleberry, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs *3* inches thick
Typical profile:
0 to 12 inches - very dark grayish brown and dark brown silt loam
12 to 38 inches - dark grayish brown silty clay loam
38 to 5.8 inches - dark yellowish brown and yellowish brown silty clay loam
58 inches - weathered siltstone
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have weathered siltstone at a depth of less than 40 inches
Soils that have basalt at a depth of 40 to 60 inches
Soils that have slopes of more than 30 percent
Soils that have more than 15 percent hard rock fragments throughout the profile

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Erosion by water, susceptibility of upper layer to compaction
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland

Mean site index for stated species: Western hemlock - 156 (based on 100-year site curve); 112 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50 year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 107,380 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Mean site index for stated species: Douglas-fir - 165 (based on 100-year site curve); 125 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 180 (based on 100-year site curve)

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
Susceptibility of cut and fill areas to erosion is moderate.
Adequately designed road drainage reduces the risk of erosion.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings.

Suitable management practices:
Use ground skidding equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

61E-Templeton-Ecola silt loams, 30 to 60 percent slopes.

Composition

Templeton soil and similar inclusions - 50 percent
Ecola soil and similar inclusions - 40 percent
Contrasting inclusions - 10 percent

Templeton Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants: Western hemlock, Sitka spruce, Douglas-fir, red alder, salal, salmonberry, western swordfern, red huckleberry, vine maple, Oregon oxalis
Organic mat on surface: Moss, needles; and twigs 3 inches thick
Typical profile:
0 to 12 inches - very dark grayish brown and dark brown silt loam

12 to 38 inches - dark grayish brown silty clay loam
38 to 58 inches - dark yellowish brown and yellowish brown silty clay loam
58 inches - weathered siltstone

Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 40 to 60 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Ecola Soil

Position on landscape: Mountainsides
Slope range: 30 to 60 percent
Elevation: 100 to 1,600 feet
Native plants Sitka spruce, western hemlock, Douglas-fir, red alder, salal, salmonberry, western swordfern, red huckleberry, Oregon oxalis
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:
0 to 7 inches - very dark grayish brown silt loam
7 to 16 inches - dark brown silty clay loam
16 to 37 inches - dark yellowish brown silty clay loam
37 inches - weathered siltstone
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 7 to 9 inches
Potential rooting depth: 20 to 40 inches
Runoff: Rapid
Hazard of erosion by water: Severe

Included Areas

Soils that have basalt at a depth of 20 to 60 inches
Soils that are coarser textured throughout the profile
Soils that have more than 15 percent basalt fragments throughout the profile
Soils that have slopes of less than 30 percent or more than 60 percent

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Slope, erosion by water, rooting depth in some areas
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 47 to 52 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 100 to 210 days

Woodland
Templeton Soil
Mean site index for stated species: Western hemlock - 156 (based on 100-year site curve); 112 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 266 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 107,380 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old
Mean site index for stated species: Douglas-fir - 165 (based on 100-year site curve); 125 (based on 50-year site curve)
Mean site index for stated species: Sitka spruce - 180 (based on 100-year site curve)
Ecola Soil
Mean site index for stated species: Western hemlock - 159 (based on 100-year site curve); 117 (based on 50-year site curve)
Growth at culmination of mean annual increment (CMAI): 252 cubic feet per acre in a stand of 50-year-old trees 1.5 inches or larger in diameter at breast height
Estimated total production per acre: 110,110 board feet (International rule, one-fourth-inch kerf) from a fully stocked stand of trees 70 years old

General management considerations:
Slope limits the kinds of equipment that can be used in forest management.
Highlead logging is more efficient than most other methods and is less damaging to the soil surface.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
The soil is subject to sliding and slumping because it is very plastic and is underlain by highly fractured bedrock.
Susceptibility of cut and fill areas to erosion is high.
Cutbanks occasionally slump when saturated.
Adequately designed road drainage reduces the risk of erosion.
Spoil from excavations is subject to rill and gully erosion and to sloughing.
Because roots are restricted by bedrock, trees on the Ecola soil commonly are subject to windthrow.
Windthrow is a hazard on the Ecola soil when it is saturated and winds are strong.

Reforestation occurs naturally in cutover areas if a seed source is present.
Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting western hemlock, Sitka spruce, or Douglas-fir seedlings (fig. 9).

Suitable management practices:

Use highlead or other logging that fully or partially suspends logs because it is less damaging to the soil.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

62D-Tolany silt loam, 3 to 30 percent slopes.

Composition

Tolany soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Figure 9.-Area of Templeton-Ecola silt loams, 30 to 60 percent slopes, that supports mixed coniferous trees.

Tolany Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 1,600 to 2,800 feet
Native plants: Douglas-fir, western hemlock, Pacific silver fir, noble fir, red alder, vine maple, salal, cascade Oregon-grape, red huckleberry, western swordfern, western brackenfern
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 6 inches - dark reddish brown silt loam
6 to 60 inches - reddish brown and dark brown silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that are wet
Soils that have basalt at a depth of 40 to 60 inches
Soils that have more than 35 percent hard rock fragments between depths of 10 and 40 inches
Soils that have weathered siltstone at a depth of 40 to 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors
Soil-related factors: Erosion by water, susceptibility of upper layer to compaction, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 70 to 90 inches
Soil temperature - 42 to 46 degrees F
Frost-free period - 60 to 100 days

Woodland
Mean site index for stated species: Douglas-fir - 138 (based on 100-year site curve); 111 (based on 50-year site curve)
Estimated total production per acre: 75,200 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 142 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Careless use of wheeled and tracked equipment disturbs the protective layer of duff.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Rilling and gullying can occur if the soil is used for yarding and skid trails, if firebreaks are constructed, or if the surface is otherwise disturbed.
Adequately designed road drainage reduces the risk of erosion.
Constructing roads at midslope results in large cuts and fills, which increases the risk of erosion.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Logging roads require suitable surfacing for year-round use.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Trees suitable for planting include Douglas-fir and western hemlock.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
To reduce compaction use suitable methods of harvest, lay out skid trails in advance, and harvest when the soil is least susceptible to compaction.
Reduce the risk of erosion by avoiding excessive disturbance of the soil, seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Help to ensure establishment and survival of seedlings by selecting adapted plants.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

63D-Tolke silt loam, 3 to 30 percent slopes.

Composition

Tolke soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Tolke Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 900 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, bigleaf maple, vine maple, cascade Oregon-grape, salal, western swordfern, red huckleberry, salmonberry
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:
0 to 29 inches - dark brown silt loam
29 to 60 inches - strong brown silty clay loam and silt loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that are wet
Soils that have weathered siltstone at a depth of 40 to 60 inches
Soils that have basalt at a depth of 40 to 60 inches
Soils that have more than 35 percent rock fragments between depths of 10 and 40 inches

Major Uses

Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Erosion by water, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 47 to 50 degrees F
Frost-free period - 100 to 200 days

Woodland

Mean site index for stated species: Douglas-fir - 168 (based on 100-year site curve); 130 (based on 50-year site curve)
Estimated total production per acre: 101,280 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 179 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast-height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Adequately designed road drainage reduces the risk of erosion.
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

64D-Tolke-Alstony complex, 3 to 30 percent slopes.

Composition

Tolke soil and similar inclusions - 45 percent
Alstony soil and similar inclusions - 40 percent

Contrasting inclusions - 15 percent

Tolke Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 900 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, cascade Oregon-grape, salal, western swordfern, red huckleberry, salmonberry
Organic mat on surface: Moss, needles, and twigs 3 inches thick
Typical profile:
0 to 29 inches - dark brown silt loam
29 to *60* inches - strong brown silty clay loam and silt loam
Depth class: Very deep (60 inches or more)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 10 to 13 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate

AIstony Soil

Position on landscape: Mountaintops
Slope range: 3 to 30 percent
Elevation: 900 to 1,600 feet
Native plants: Douglas-fir, western hemlock, red alder, vine maple, salal, cascade Oregon-grape, western swordfern, red huckleberry
Organic mat on surface: Moss, needles, and twigs *2* inches thick
Typical profile:
0 to 7 inches - dark reddish brown gravelly loam
7 to 47 inches - reddish brown very gravelly loam
47 to 53 inches - dark brown extremely cobbly loam
53 inches - basalt
Depth class: Deep (40 to 60 inches)
Drainage class: Well drained
Permeability: Moderate
Available water capacity: 5 to 7 inches
Potential rooting depth: 40 to 60 inches
Runoff: Medium
Hazard of erosion by water: Moderate

Included Areas

Soils that have slopes of more than 30 percent
Soils that are wet
Soils that have weathered siltstone at a depth of 40 to 60 inches

Major Uses
Woodland, wildlife habitat

Major Management Factors

Soil-related factors: Erosion by water, susceptibility of the upper layer to compaction, gravel in some areas, low amount of extractable phosphorus
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 47 to 50 degrees F
Frost-free period - 100 to 200 days

Woodland

Tolke Soil
Mean site index for stated species: Douglas-fir - 168 (based on 100-year site curve); 130 (based on, 50-year site curve)
Estimated total production per acre: 101,280 board feet (International rule, one-eighth-inch kerf) from a fully stocked stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 179 cubic feet per acre in a stand of 60-year-old trees 1.5 inches or larger in diameter at breast height
AIstony Soil
Mean site index for stated species: Douglas-fir - 164 (based on 100-year site curve); 122 (based on 50-year site curve)
Estimated total production per acre: 98,240 board feet (International rule, one-eighth-inch kerf) from a stand of trees 80 years old
Growth at culmination of mean annual increment (CMAI): 174 cubic feet per acre in a stand of 60 year-old trees 1.5 inches or larger in diameter at breast height

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
Disturbing the soil excessively in harvesting timber and building roads increases the loss of soil, which in turn leaves a greater number of rock fragments on the surface of the Alstony soil.
Logging roads require suitable surfacing for year-round use.
Susceptibility of cut and fill areas to erosion is moderate.
Cutbanks occasionally slump when saturated.
Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying. A plant cover or water bars are needed.
The waste material from roadbuilding can damage vegetation. It is also a potential source of sedimentation.

Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Reduce the risk of erosion by seeding roads and landings, installing water bars and culverts, and seeding cuts and fills.
Avoid excessive damage to the soil and to the vegetation downslope from roadbuilding sites by removing waste material.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

65A-Treharne silt loam, 0 to 3 percent slopes.

Composition
Treharne soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Treharne Soil

Position on landscape: Stream terraces (fig. 10)
Slope range: 0 to 3 percent
Elevation: 350 to 600 feet
Native plants: Douglas-fir, western hemlock, western redcedar, bigleaf maple, red alder, cascade Oregon-grape, common snowberry, western swordfern, salal, red huckleberry
Typical profile..
0 to 14 inches - very dark grayish brown silt loam
14 to 32 inches - dark brown silt loam
32 to 50 inches - dark yellowish brown silt loam
50 to 60 inches - dark grayish brown silt loam
Depth class: Very deep (60 inches or more)
Drainage class: Moderately well drained
Permeability: Moderately slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more
Hazard of erosion by water: Slight
Depth to apparent water table: November through April - 24 to 36 inches

Included Areas

Soils that are wet
Soils that are well drained

Major Uses
Cropland, homesites

Major Management Factors

Soil-related factors Load supporting capacity, wetness, susceptibility of the upper layer to compaction
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 52 degrees F
Frost-free period - 145 to 210 days

Cropland
Most climatically adapted crops can be grown if adequate drainage is provided.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Wetness limits the production of deep-rooted crops.
Drainage should be maintained throughout the growing season.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Plant deep-rooted crops in areas where natural drainage is adequate or where a drainage system has been installed.
Use tile drains to reduce wetness if a suitable outlet is available.
Irrigate during the dry period in summer.
Regulate the application of irrigation water to control runoff and erosion.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures and by rotating crops.
Maintain tilth by returning crop residue to the soil, using a cropping system that includes grasses, legumes, or grass-legume mixtures, and rotating crops.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, and fertilizing.

Building Site Development

General management considerations
Septic tank absorption fields may function poorly because of the apparent water table.

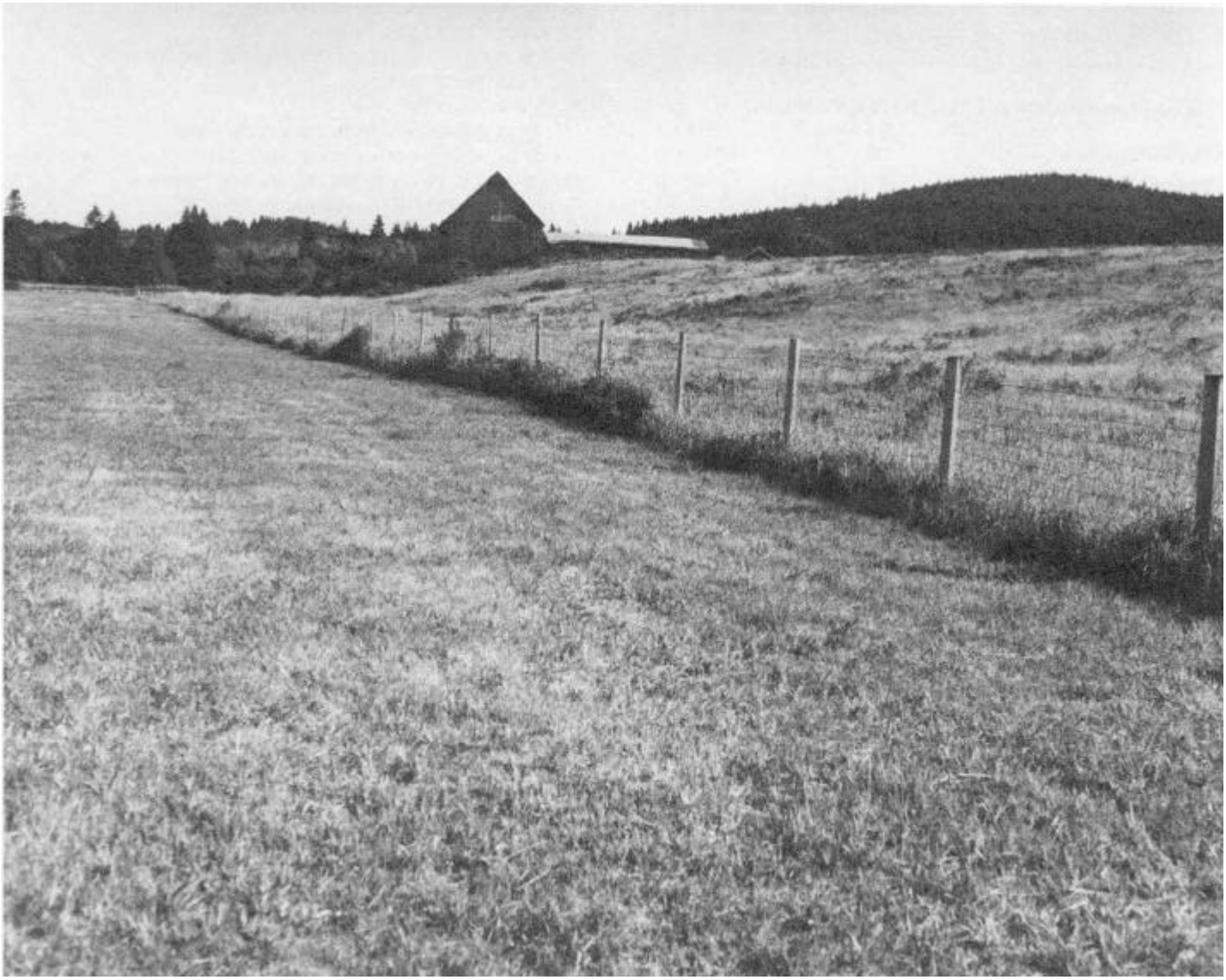

Figure 10.-Area of Treharne silt loam, 0 to 3 percent slopes, on lower terrace.

An alternate onsite sewage system or a community sewage system is needed.

Suitable management practices:

Reduce wetness by installing drain tile around footings.

Stockpile topsoil and use it to reclaim areas disturbed during construction.

Design buildings and roads to offset the limited ability of the soil to support a load.

Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.

Compensate for the restricted permeability by increasing the size of the absorption field and backfilling trenches with porous material.

If the soil is to be used as a base for roads and streets, mix it with sand and gravel to increase its strength and stability.

Provide roads for year-round use with heavy base rock.

Install culverts to carry seasonal runoff where road cross natural drainageways.

66-Tropofluvents, 0 to 3 percent slopes.

Composition
Tropofluvents - 80 percent
Contrasting inclusions - 20 percent

Tropofluvents

Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 25 to 500 feet
Reference profile:
0 to 5 inches - dark brown silt loam
5 to 10 inches - dark yellowish brown sandy loam
10 to 15 inches - dark brown silt loam
15 to 60 inches - stratified gravel, cobbles, and sand
Depth class: Deep to very deep (40 to 60 inches or more)
Drainage class: Moderately well drained to excessively drained
Permeability: Moderate to very rapid
Available water capacity: 1 to 12 inches
Potential rooting depth: 10 to 60 inches
Runoff: Slow
Hazard of erosion by water: Slight
Frequency of flooding: Frequent

Included Areas

Soils that have slopes of more than 3 percent
Soils that are wet

Major Use
Wildlife habitat

Major Management Factors
Soil-related factors: Flooding, gravel in some areas, available water capacity in some areas
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 50 to 53 degrees F (varies 9 degrees or less from summer to winter)
Frost-free period - 180 to 245 days

67-Tropopsamments, 0 to 15 percent slopes.

Composition
Tropopsamments - 90 percent
Contrasting inclusions - 10 percent

Tropopsammments

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 15 percent
Elevation: 10 to 30 feet
Native plants: Willow, cottonwood, red alder, blackberry, grass
Reference profile:
0 to 2 inches - very dark gray sand
2 to 60 inches - dark gray sand
Depth class: Very deep (60 inches or more)
Drainage class: Excessively drained
Permeability: Very rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 20 inches or more
Runoff: Slow
Hazard of erosion by wind: Moderate
Frequency of flooding: Rare

Included Areas
Contrasting inclusion:
Soils that are wet

Major Use
Wildlife habitat

Major Management Factors
Soil-related factors: Available water capacity, flooding in some areas, wind erosion, available water capacity, slope in some areas
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 200 to 245 days

68-Udifluvents-Hapludalfs complex, 0 to 15 percent slopes.

Composition
Udifluvents - 45 percent
Hapludalfs - 40 percent
Contrasting inclusions - 15 percent

Udifluvents

Position on landscape: Flood plains
Slope range: 0 to 3 percent
Elevation: 20 to 700 feet
Native plants: Red alder, vine maple, Sitka spruce, western swordfern, oxalis, bigleaf maple, salmonberry, moss, forbs
Reference profile:
0 to 8 inches - dark brown loam
8 to 14 inches - dark brown silt loam
14 to 38 inches - dark brown very gravelly loam and extremely gravelly loamy sand
38 inches - extremely gravelly sand

Depth class: Deep (40 to 60 inches or more)
Drainage class: Moderately well drained to somewhat excessively drained
Permeability: Moderately rapid
Available water capacity: 2 to 11 inches
Potential rooting depth: 30 to 40 inches or more
Runoff: Slow
Hazard of erosion by water: Slight
Frequency of flooding: Frequent

Hapludalfs

Position on landscape: Stream terraces
Slope range: 0 to 15 percent
Elevation: 20 to 700 feet
Native plants: Douglas-fir, western hemlock, red alder, blue elderberry, red huckleberry, tansy ragwort, western brackenfern, grasses
Reference profile:
0 to 4 inches - black silt loam
4 to 11 inches - very dark grayish brown silt loam
11 to 32 inches - dark yellowish brown silt loam
32 to 44 inches - yellowish brown loam
44 to 60 inches - grayish brown loamy fine sand
Depth class: Deep to very deep (40 to 60 inches or more)
Drainage class: Well drained to somewhat poorly drained
Permeability: Moderate to moderately slow
Available water capacity: 8 to 10 inches
Potential rooting depth: 40 to 60 inches or more
Runoff: Slow to medium
Hazard of erosion by water: Slight to moderate

Included Areas

Soils that have slopes of more than 15 percent
Soils that are clayey
Soils that are poorly drained
Soils that have more than 35 percent rock fragments between depths of 10 and 40 inches

Major Uses
Wildlife habitat, woodland

Major Management Factors
Soil-related factors: Erosion by water in some areas, flooding in some areas, wetness in some areas, gravel in some areas, susceptibility of the upper layer to compaction in some areas
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 53 degrees F
Frost-free period - 145 to 245 days

Woodland
Site index and yields: Not estimated.

General management considerations:
Wheeled and tracked equipment can be used in the more gently sloping areas, but cable yarding generally is safer and disturbs the soil less.
Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
When wet, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.
Logging roads require suitable surfacing for year-round use.
Adequately designed road drainage reduces the risk of erosion.
Mortality of seedlings may be high in areas that are subject to flooding.
Unless the site is adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.
Carefully managed reforestation reduces competition from undesirable understory plants.
Reforestation can be accomplished by planting Douglas-fir or western hemlock seedlings.

Suitable management practices:
Use conventional equipment in harvesting, but limit its use when the soil is wet.
Use highlead or other cable logging.
Reduce the risk of erosion by seeding roads, cutbanks, and landings and installing water bars and culverts.
Prepare the site carefully to control competing vegetation.
Hand plant nursery stock to establish or improve a stand.
Improve stands by thinning before trees reach commercial size and by selective cutting of mature trees.

69-Udipsamments, 0 to 15 percent slopes.

Composition
Udipsamments - 95 percent
Contrasting inclusions - 5 percent

Udipsamments

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 15 percent
Elevation: 0 to 30 feet
Native plants: Black cottonwood, willow, blackberry
Reference profile:
0 to 2 inches - dark grayish brown sand
2 to 14 inches - dark gray sand
14 to 60 inches - gray sand
Depth class: Very deep (60 inches or more)

Drainage class: Excessively drained
Permeability: Very rapid
Available water capacity: 2 to 5 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by wind: Moderate
Frequency of flooding: Rare

Included Areas

Soils that are gravelly throughout the profile

Major Use
Wildlife habitat

Major Management Factors
Soil-related factors: Available water capacity, gravel in some areas, flooding in some areas, slope in some areas
Climatic factors (mean annual):
Precipitation - 60 to 80 inches
Soil temperature - 49 to 53 degrees F
Frost-free period - 200 to 245 days

70C-Waldport fine sand, 3 to 15 percent slopes.

Composition
Waldport soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Waldport Soil
Position on landscape: Dunes
Slope range: 3 to 15 percent
Elevation: 10 to 60 feet
Native plants: Shore pine, Sitka spruce, beachgrasses, Scotch-broom, salal
Typical profile:
0 to 5 inches - very dark brown and dark brown fine sand
5 to 15 inches - pale brown fine sand
15 to 60 inches - light brownish gray fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Permeability: Very rapid
Available water capacity: 3 to 5 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion: By water - slight; by wind - severe

Included Areas
Soils that have slopes of more than 15 percent
Soils that are wet

Major Uses
Homesites, wildlife habitat

Major Management Factors
Soil-related factors: Erosion by wind, slope in some areas, permeability, available water capacity, susceptibility to slumping; hazard of seepage
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 240 to 260 days

Building Site Development

General management considerations:
Excavation can expose soil material that is highly susceptible to wind erosion.
Cutbanks are not stable and therefore are subject to slumping.
Onsite sewage disposal systems may not be suitable because of the risk of polluting the ground water.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Design and construct buildings and access roads to compensate for the steepness of slope.
Revegetate disturbed areas at construction sites as soon as possible to reduce the hazard of wind erosion.
In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.
Design structures to offset the limited ability of the soil to support a load.
Construct special retainer walls in shallow excavations to prevent cutbanks from caving in.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Seed road cuts and fills to permanent vegetation.

70D-Waldport fine sand, 15 to 30 percent slopes.

Composition

Waldport soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Waldport soil

Position on landscape: Dunes
Slope range: 15 to 30 percent
Elevation: 10 to 60 feet

Native plants: Shore pine, Sitka spruce, beachgrasses, Scotch-broom, salal

Typical profile:

0 to 5 inches - very dark brown and dark brown fine sand

5 to 15 inches - pale brown fine sand

15 to 60 inches - light brownish gray fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Permeability: Very rapid

Available water capacity: 3 to 5 inches

Potential rooting depth: 60 inches or more

Runoff: Slow

Hazard of erosion: By water - slight; by wind - severe

Included Areas

Soils that are wet

Soils that have slopes of less than 15 percent

Major Uses

Homesites, wildlife habitat (fig. 11)

Major Management Factors

Soil-related factors: Available water capacity, erosion by wind, permeability, slope, hazard of seepage

Climatic factors (mean annual):

Precipitation - 70 to 100 inches

Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)

Frost-free period - 210 to 260 days

Building Site Development

General management considerations:

Excavation can expose soil material that is highly susceptible to wind erosion.

Cutbanks are not stable and therefore are subject to slumping.

Figure 11.-Homesites in an area of Waldport fine sand, 15 to 30 percent slopes.

Onsite sewage disposal systems may not be suitable because of the risk of polluting the ground water.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:
Design and construct buildings and access roads to compensate for the steepness of slope.
Revegetate disturbed areas at construction sites as soon as possible to reduce the hazard of wind erosion.
In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.
Design structures to offset the limited ability of the soil to support a load.
Construct special retainer walls in shallow excavations to prevent cutbanks from caving in
Design roads and streets to compensate for the instability of the soil.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Reduce the risk of erosion on steep cut and fill slopes by establishing a plant cover on them.

71B-Walluski silt loam, 0 to 7 percent slopes.

Composition
Walluski soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Walluski Soil

Position on landscape: Terraces
Slope range: 0 to 7 percent
Elevation: 50 to 300 feet
Native plants: Sitka spruce, western hemlock, red alder, salmonberry; salal, western swordfern, red huckleberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 14 inches - very dark grayish brown silt loam
14 to 21 inches - dark brown silt loam
21 to 60 inches - dark yellowish brown, yellowish brown, and light brownish gray, mottled silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: 9 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Slow
Hazard of erosion by water: Slight
Depth to perched water table: November to May - 24 to 36 inches

Included Areas
Soils that are wet
Soils that are well drained
Soils that have slopes of more than 7 percent
Soils that have more than 15 percent gravel and cobbles between depths of 20 and 40 inches

Major Uses

Cropland, homesites, wildlife habitat

Major Management Factors
Soil-related factors: Permeability, wetness, load supporting capacity, susceptibility of the upper layer to compaction, shrink-swell potential
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown if adequate drainage is provided.
Wetness limits the production of deep-rooted crops.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Plant deep-rooted crops in areas where natural drainage is adequate or where a drainage system has been installed.
Use tile drains to reduce wetness if a suitable outlet is available.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.

Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting early in spring or in mid-August to provide adequate cover in winter.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Building Site Development

General management considerations:
Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by shrinking and swelling and limited soil strength.
Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.
If the density of housing is moderate to high, a community sewage may be needed.

Suitable management practices:
Reduce wetness by installing drain tile around footings.
Reduce the risk of erosion and the maintenance cost by stabilizing areas that have been disturbed.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Increase the size of the septic tank absorption field to compensate for the restricted permeability.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.
Seed road cuts and fills to permanent vegetation.

71C-Walluski silt loam, 7 to 15 percent slopes.

Composition

Walluski soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Walluski Soil

Position on landscape: Terraces
Slope range: 7 to 15 percent
Elevation: 50 to 300 feet
Native plants: Sitka spruce, western hemlock, red alder, salmonberry, salal, western swordfern, red huckleberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 14 inches - very dark grayish brown silt loam
14 to 21 inches - dark brown silt loam
21 to 60 inches - dark yellowish brown, yellowish brown, and light brownish gray, mottled silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: 9 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate
Depth to perched water table: November to May - 24 to 36 inches

Included Areas
Soils that are wet
Soils that are well drained
Soils that have slopes of less than *7* percent or More than 15 percent
Soils that have more than 15 percent gravel and cobbles between depths of 20 and 40 inches

Major Uses
Cropland, homesites, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, susceptibility of the upper layer to compaction, permeability, wetness, load supporting capacity
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53-degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 245 days

Cropland
General management considerations:
Most climatically adapted crops can be grown if adequate drainage is provided.
Wetness limits the production of deep-rooted crops.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.

Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Plant deep-rooted crops in areas where natural drainage is adequate or where a drainage system has been installed.
Use tile drains to reduce wetness if a suitable .outlet is available.
Select plants that tolerate wetness or provide drainage.
Use tile drains to intercept runoff from higher lying areas.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by seeding disturbed areas to native or tame pasture plants and planting in spring to provide adequate cover in winter.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steeper slopes; rotating grazing; limiting grazing to drier periods; mowing and clipping; controlling weeds; and applying fertilizer annually.

Building Site Development

General management considerations:

Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices:

Reduce wetness by installing drain tile around footings.
Reduce the risk of erosion and the maintenance cost by stabilizing areas that have been disturbed.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated, steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Increase the size of the septic tank absorption field to compensate for the restricted permeability.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.
Reduce the risk of erosion on steep cut and fill slopes by establishing a plant cover on them.

71D-Walluski silt loam, 15 to 20 percent slopes.

Composition

Walluski soil and similar inclusions - 80 percent
Contrasting inclusions - 20 percent

Walluski Soil

Position on landscape: Terraces
Slope range: 15 to 20 percent
Elevation: 50 to 300 feet
Native plants: Sitka spruce, western hemlock, red alder, salmonberry, salal, western swordfern, red huckleberry
Organic mat on surface: Moss, needles, and twigs 1 inch thick
Typical profile:
0 to 14 inches - very dark grayish brown silt loam
14 to 21 inches - dark brown silt loam
21 to 60 inches - dark yellowish brown, yellowish brown, and light brownish gray, mottled silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: 9 to 12 inches
Potential rooting depth: 60 inches or more
Runoff: Medium
Hazard of erosion by water: Moderate
Depth to perched water table: November to May - 24 to 36 inches

Included Areas

Soils that have slopes of less than 15 percent
Soils that are well drained
Soils that are wet
Soils that have more than 15 percent gravel and cobbles between depths of 20 and 40 inches

Major Uses

Cropland, homesites, wildlife habitat

Major Management Factors

Soil-related factors: Slope, erosion by water, susceptibility of the upper layer to compaction, permeability, wetness, load supporting capacity
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)

Frost-free period - 210 to 215 days

Cropland

General management considerations:

Most climatically adapted crops can be grown if adequate drainage is provided.
Wetness limits the production of deep rooted crops.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Drainage should be maintained throughout the growing season.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Plant deep-rooted crops in areas where natural drainage is adequate or where a drainage system has been installed.
Use tile drains to reduce wetness if a suitable outlet is available.
Select plants that tolerate wetness or provide drainage.
Use tile drains to intercept runoff from higher lying areas.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Reduce the risk of erosion by using minimum tillage, seeding disturbed areas to native or tame pasture plants, and planting early in spring to provide adequate cover in winter.
Maintain the quality and quantity of forage by adjusting stocking, especially on the steep slopes; rotating grazing; limiting grazing to drier periods; controlling weeds; and applying fertilizer annually.

Building Site Development

General management considerations:

Excavation increases the risk of water erosion.
The quality of roadbeds and road surfaces can be adversely affected by limited soil strength.
Septic tank absorption fields may function poorly because of seasonal wetness and the restricted permeability of the soil.
If the density of housing is moderate to high, a community sewage system may be needed.

Suitable management practices.

Design and construct buildings and access roads to compensate for the steepness of slope.
Reduce wetness by installing drain tile around footings.
In the steeper areas, reduce erosion by disturbing only the part of the site that is used for construction.
Reduce the risk of erosion and the maintenance cost by stabilizing areas that have been disturbed.
Design buildings and roads to offset the limited ability of the soil to support a load.
Offset the risk of corrosion to uncoated steel and concrete by using corrosion-resistant material for foundations, basements, and underground utilities.
Install septic tank absorption lines in adjacent areas that are more nearly level.
Increase the size of the septic tank absorption field to compensate for the restricted permeability.
Build roads in the less sloping areas of the unit to reduce the amount of cut and fill needed.
Provide a stable base and an adequate wearing surface to improve trafficability of roads.
Install culverts to carry seasonal runoff where roads cross natural drainageways.
Reduce the risk of erosion on steep cut and fill slopes by establishing a plant cover on them.

72A-Warrenton loamy fine sand, 0 to 3 percent slopes.

Composition

Warrenton soil and similar inclusions - 85 percent
Contrasting inclusions - 15 percent

Warrenton Soil

Position on landscape: Interdunal areas
Slope range: 0 to 3 percent
Elevation: 10 to 20 feet
Native plants Sitka spruce, willows, rushes, sedges, skunkcabbage, salal
Organic mat on surface: Moss, twigs, roots, needles, and leaves 3 inches thick
Typical profile:
0 to 11 inches - black loamy fine sand
11 to 22 inches - very dark gray, mottled loamy fine sand
22 to 60 inches - very dark gray, mottled fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Permeability: Rapid
Available water capacity: 4 to 6 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded

Depth to apparent water table: January through December - 12 inches above the surface to 24 inches below the surface
Hazard of erosion: By water - slight; by wind - slight

Included Areas

Soils that are excessively drained
Soils that have a layer of iron accumulation in the profile
Soils that are gravelly and cobbly between depths of 10 and 60 inches

Major Uses

Cropland, wildlife habitat, wetland wildlife habitat in some areas

Major Management Factors

Soil-related factors: Inadequate drainage outlets, wetness, plant competition
Climatic factors (mean annual):
Precipitation - 70 to 100 inches
Soil temperature - 49 to 53 degrees F (varies less than 9 degrees from summer to winter)
Frost-free period - 210 to 260 days

Cropland

General management considerations:
Water tolerant plants can be grown.
Suitable crops for planting are grasses and legumes.
Grasses and legumes grow well if they are adequately fertilized.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Wetness limits the choice of plants and the production of deep-rooted crops.
Drainage should be maintained throughout the growing season.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:
Either select plants that tolerate wetness or provide drainage.
Install surface drains to reduce the length of the periods of ponding and to inhibit the growth of the less palatable water tolerant plants.
Use open ditches or tile drains to remove water on or near the surface.
Maintain or improve fertility by using a cropping system that includes grasses, legumes, or grass-legume mixtures.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

73A-Wauna-Locoda silt loams, protected, 0 to 3 percent slopes.

Composition

Wauna soil and similar inclusions - 50 percent
Locoda soil and similar inclusions - 35 percent
Contrasting inclusions - 15 percent

Wauna Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 3 percent
Elevation: 10 to 15 feet
Native plants: Oregon ash, willow, cottonwood, grasses, forbs, rushes
Typical profile:
0 to 9 inches - very dark grayish brown silt loam
9 to 18 inches - dark grayish brown, mottled silt loam
18 to 60 inches - grayish brown and gray, mottled silt loam
Depth class: Very deep (60 inches or more)
Drainage class: Poorly drained
Permeability: Moderately slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Very slow
Hazard of erosion by water: Slight
Frequency of flooding: Rare
Depth to apparent water table: December through April - 24 to 60 inches

Locoda Soil

Position on landscape: Tide-influenced flood plains
Slope range: 0 to 3 percent
Elevation: 5 to 10 feet
Native plants: Willow, Oregon ash, grasses, forbs, rushes
Typical profile:
0 to 10 inches - very dark grayish brown and . grayish brown, mottled silt loam
10 to 26 inches - gray, mottled silty clay loam
26 to 60 inches - gray silt loam
Depth class: Very deep (60 inches or more)
Drainage class: Very poorly drained
Permeability: Moderately slow
Available water capacity: 10 to 12 inches
Potential rooting depth: 60 inches or more for water tolerant plants
Runoff: Ponded
Hazard of erosion by water: Slight
Frequency of flooding: Rare

Depth to apparent water table: November through May - 12 inches above the surface to 24 inches below the surface

Included Areas

Soils that are organic throughout the profile
Soils that have a sandy layer at a depth of 20 inches or more

Major Uses

Cropland, wildlife habitat

Major Management Factors

Soil-related factors: Flooding, wetness, inadequate drainage outlets, susceptibility of the upper layer to compaction

Climatic factors (mean annual):

Precipitation - 60 to 80 inches
Soil temperature - 50 to 53 degrees F
Frost-free period - 165 to 210 days

Cropland

General management considerations:

Most climatically adapted crops can be grown if adequate drainage and protection from flooding are provided.
Suitable crops for planting are grasses. and legumes.
Wetness limits the choice of plants, the period of grazing, acrd the production of deep-rooted crops and increases the risk of winterkill.
Drainage should be maintained throughout the growing season.
Providing drainage is difficult because most areas have poor outlets.
Most crops respond to nitrogen, phosphorus, potassium, and lime.
Legumes respond to phosphorus and lime. Additions of potassium may also be needed.
Grazing when the soil is wet results in compaction of the upper layer, poor tilth, and excessive runoff.

Suitable management practices:

Either select plants that tolerate wetness or provide drainage.
Maintain water control structures to reduce the risk of flooding.
Use open ditches or tile drains to remove water on or near the surface.
Use tile drains to reduce wetness if a suitable outlet is available.
Irrigate during the dry period in summer.
Regulate the rate of irrigation to prevent a rise in the level of the water table.
Regulate the application of irrigation water to control runoff and erosion.
Apply enough water to wet the root zone but not so much that it leaches plant nutrients.
Maintain the quality and quantity of forage by rotating grazing, limiting grazing to drier periods, mowing and clipping, controlling weeds, and applying fertilizer annually.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity. and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

By Donald Leach, district conservationist, Soil Conservation Service.

General management needed for crops and for hay and pasture is suggested in this section. 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 commonly grown are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Grasses and legumes for pasture and forage are the main crops in the survey area. Small grain is grown only after the pasture is plowed and before it is reseeded. This rotation helps to control insects and provides adequate time to break down the existing sod for better seedbed preparation before permanent forage is planted.

The small-grain crops grown are mainly oats and barley. They are used for grazing, silage, or hay (fig. 12). Pasture grasses include orchardgrass, perennial ryegrass, tall fescue, and meadow foxtail. Legumes include New Zealand clover and lotus major. There is usually enough precipitation late in spring and early in summer to sustain the pasture and permit grain crops to mature.

About 52,000 acres is suitable for tillage. The tilled land is used mainly as pasture for beef cattle, dairy cattle, sheep, horses, and goats. Many farms have a few fruit trees and produce a few cool-weather garden crops. Holly, Christmas trees, cranberries, caneberries, blueberries, peas, and nursery stock are grown commercially. Climatic conditions in the survey area are favorable for producing high-quality artichokes, flower bulbs, and cole crops.

Drainage is a major problem on many farms because rainfall is heavy and many of the soils are in low-lying areas and are slowly permeable. Drainage is needed on the Bergsvik, Brallier, Brenner, Clatsop, Coquille, Croquib, Hebo, and Warrenton soils. It is also beneficial on the Nestucca soils. The Bergsvik, Brallier, Coquille, and Clatsop soils make up most of the drained land because they are located on the tidal flood plains of the Columbia River estuary. Dikes constructed in the early 1900's protect these lands from tidal inundation. Underground tile, open drainage ditches, sloughs, tide gates, and pumps are used to remove the accumulated water from these areas. Constant maintenance is needed to keep the drainage systems functioning properly.

Other soils in the survey area that have restricted drainage need only underground tile or interception drainage ditches.

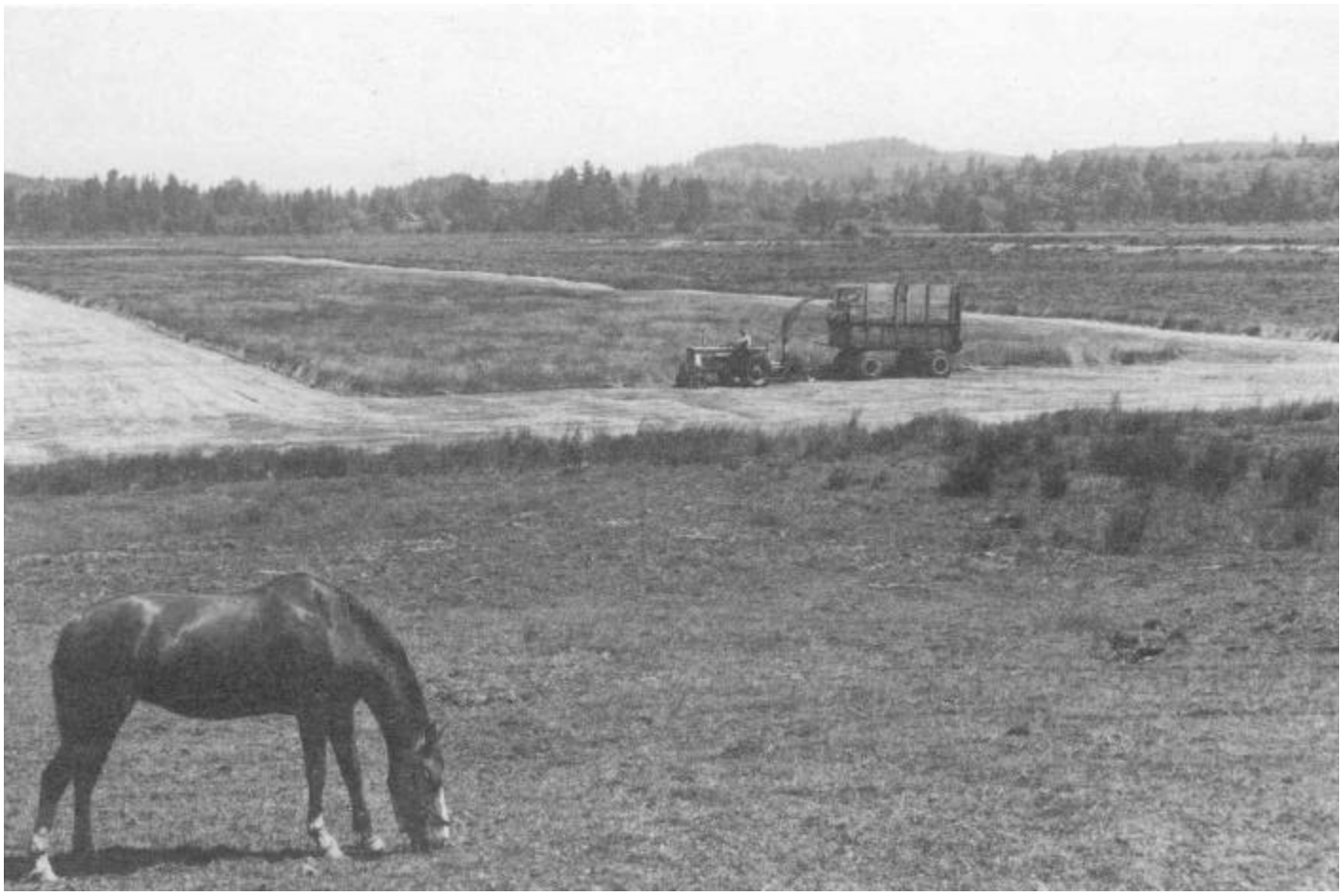

Figure 12.-Pasture and hay in an area of Coquille-Clatsop complex, protected, 0 to 1 percent slopes.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction And optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase, as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information

about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take. into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only subclass is used in this survey (table 5). These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have 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 VIll soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, Ile. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Woodland Management and Productivity

By James F. McClinton, forester, Soil Conservation Service.

Clatsop County is recognized as a major timber growing area in North America. The potential productivity is high because of the favorable climate, fertile soils, and well suited timber species.

Eighty-two percent of Clatsop County is classified as commercial forest land. Sixty-eight percent of the commercial forest land is privately owned. The rest is publicly owned, mainly by the state, county, and municipality.

The town of Astoria is a major center for the forest products industry on the north coast of Oregon. This is due in part to the presence of an excellent deep-water port that makes possible the export of raw logs and finished lumber to both foreign and domestic markets.

The county has several large sawmills that produce lumber, plywood, veneer, and wood chips suitable for pulp. Wood chips suitable for both high-grade and low-grade paper products are shipped to paper mills outside the county, both domestic and foreign. There are several smaller sawmills and a few specialty mills that produce products such as shakes from western redcedar.

The primary coniferous species are western hemlock, Douglas-fir, and Sitka spruce (fig. 13). The primary hardwood species are red alder and bigleaf maple, which grow best in the inland areas.

The State Department of Forestry and local fire districts provide fire protection services. The increasing population and recreational activities in the county make accidental fires a constant threat, especially during dry periods in summer.

Western hemlock is susceptible to several trunk, butt, and root rots. It is also attacked by the hemlock looper *(Lambdina Ascellaria),* which is the most serious threat of damage by insects. The Douglas-fir beetle *(Dendroctonus pseudotsugae) is* the principal insect that attacks Douglas-fir. Laminated root rot (*Phylinius* weiru) is the most serious fungus enemy of Douglas-fir. The Sitka spruce weevil (*Dissodes sitchensis)* kills the terminal shoots of spruce, and the spruce aphid, *(Aphis abientina)* causes the greatest amount of damage to Sitka spruce. Other diseases and insects may be serious threats in individual stands of trees. The amount of damage varies from year to year.

In winter, ice and snow damage to the tops of trees at higher elevations reduces yields and the quality of timber, especially Douglas-fir trees. This damage results

Figure 13.-Sitka spruce in an area of Klootchie silt loam, 3 to 30 percent slopes.

in development of double tops and bayonetlike tops. Soils that support stands of timber susceptible to this damage are those of the Caterl, Laderly, McMille, Murtip, Newanna, and Tolany series.

The principal forest cover type in the county is the Sitka spruce-western hemlock type, which is associated with the Pacific coast fog belt.

The other dominant forest cover type is the western hemlock-Pacific Douglas-fir type, which typically has small amounts of western redcedar. A small, distinctive area along the coast supports the shore pine cover type. This type is the result of large-scale plantings done in conjunction with dune and beach stabilization projects.

The majority of the forest land in the county does not provide suitable forage for livestock grazing but does provide forage for many species of wildlife. Elk and deer use the forage in recently harvested areas, and they use the dense stands of timber for cover.

Soils vary in their ability to produce trees. Depth, fertility, texture, and the available water capacity influence tree growth. Elevation, aspect, soils, and climate determine the kinds of trees that can be expected to grow on any site. Available water capacity and the depth of the root zone are of major importance. Elevation and aspect are of particular importance in mountainous areas. The forested soils in the survey area range from shallow to very deep, from nongravelly to extremely gravelly, and from fine textured to coarse textured. Because of differences among the soils, as well as differences in climate, topography, and geology, the forests vary in composition and productivity.

Soil surveys are important to forest land managers. as they seek ways to increase the productivity of forest land. Some soils respond better to fertilizer than do others, some are more susceptible to landsliding and erosion after roads are built and timber is harvested, and some require special effort when harvesting timber and reforesting. The description of each map unit in this survey suitable for producing timber presents information concerning forest land productivity and limitations for harvesting timber and names common forest understory plants. Table 6 summarizes the forestry information given in the detailed map unit descriptions. The soils are rated for a number of factors to be considered in management: In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Equipment limitations ratings refer to the limits placed upon the use of equipment, year-round or seasonally, as a result of soil characteristics. A rating of *slight* indicates that use of equipment is not normally restricted in kind or time of year because of soil factors; *moderate* indicates a seasonal limitation (usually less than 4 months) because of soil wetness, a fluctuating water table, susceptibility to compaction, or some other factor, and *severe* indicates a seasonal limitation, a need for special equipment (such as a cable-yarding logging system), or a hazard in the use of equipment. Steepness of slope, wetness, and susceptibility of the soil to compaction are the main factors that cause equipment limitations. As slope gradient and length increase, it becomes more difficult to use wheeled equipment. Where slopes are even steeper, tracked equipment cannot be operated safely and more sophisticated systems must be used. Soil wetness, especially in combination with fine soil texture, can severely limit the use of equipment, making harvesting practical only during dry periods.

Seedling mortality ratings refer to the probability of mortality of naturally occurring or planted tree seedlings as influenced by kinds of soil or topography. Plant competition is not considered in this rating. The ratings apply to seedlings from good stock that is planted properly during a period of sufficient soil moisture. *Slight* indicates that no problem is expected under usual conditions; *moderate* indicates that some. problems of mortality can be expected and that extra precautions are advisable; and *severe* indicates that mortality will be high and extra precautions are essential for successful reforestation. Wetness of the soil, droughtiness of the surface layer (especially on south- and southwest-facing side slopes), or position on ridgetops account for seedling mortality problems. To offset these limitations, larger than usual planting stock, special site preparation, surface drainage, or reinforcement plantings may be needed.

Ratings of *windthrow hazard* consider the soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that trees normally are not blown down by wind (strong winds may break trees but not uproot them); moderate indicates that an occasional tree may blow down during periods of excessive Wetness combined with strong winds; and severe indicates that many trees may be expected to be blown down during periods of soil wetness and moderate or strong winds.

Restricted rooting depth as a result of a high water table, underlying bedrock, an impervious layer, and poor anchoring of roots because the surface layer and subsoil are loose makes trees more subject to windthrow or tipover. Moderate and severe ratings indicate the need for more care in thinning the edges of timber stands, a plan calling for periodic salvage of windthrown trees, and an adequate road and trail system to allow for salvage operations.

Ratings of plant competition refer to the likelihood of invasion of brushy plants when openings are made in the tree canopy. A rating of slight indicates that unwanted brushy plants are not likely to delay the establishment of natural reforestation and that planted seedlings have good prospects for development without undue competition; moderate indicates that competition can be expected to reduce the establishment of natural or planted seedlings in the absence of intensive site preparation and maintenance; and severe indicates that competition can be expected to prevent establishment of adequate natural or planted seedlings unless intensive site preparation and maintenance are provided. Favorable climate and productive soils encourage plant

competition. Generally, brush invades less as elevation increases. The key to predicting brush competition problems commonly is the quantity and proximity of seed sources of undesirable plants. Moderate and severe ratings indicate the need for careful and thorough postharvest cleanup in preparation for reforestation and the possibility of mechanically or chemically treating brush to retard the growth and allow seedlings to develop.

The potential productivity of important trees on a soil is expressed as a site index. This index is determined by taking height and age measurements on selected trees within stands of a given species. The procedure and technique for doing this is given in the site index tables used for the Clatsop County Soil Survey (4, 8, 9; 10, 20). The site index applies to fully stocked, even-aged, unmanaged stands growing on a particular soil. The greatest timber yields, commonly expressed in board-feet or cubic feet per acre, can be expected from soil map units with the highest site indexes. Site index values can be converted into estimated yields at various ages by carefully using the appropriate "yield" tables (4, 9, 10). Important trees are listed in the same order as that of their general occurrence as observed on the map unit. Usually only one or two tree species predominate.

Trees to plant are those that are used for reforestation or, if suitable conditions exist, natural regeneration. Species listed are suited to the soils and will produce a commercial wood crop. Desired product, topographic position, and personal preference are three factors of many that can influence the choice of trees to use for reforestation.

Recreation

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in table 8 and interpretations for septic tank absorption fields in table 9.

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

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

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

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

Wildlife Habitat

Soils directly affect the kind and amount of vegetation available to wildlife as food and cover. The kind and abundance of wildlife that populate an area depend on the amount and distribution of food, cover, and water.

Wildlife habitat varies greatly throughout the survey area. The kind, abundance, and management of wildlife species in the county are related generally to four landscape zones.

Flood plain zone.-This zone consists of general soil map units 1 and 6 and the flood plain areas of units 2, *3,* and 7. The native vegetation includes wetland plants and variable stands of hardwoods, young conifers, shrubs, and herbaceous plants. Many of these areas have been

diked and drained and planted to pasture. The areas of pasture that are surrounded by woodland and shrubs are used for grazing by elk and deer. The wetland areas are used by ducks, geese, seagulls, herons, bald eagles, hawks, and other birds. Beaver, mink, nutria, muskrat, opossum, and salamanders are common along streams. Marine species of fish, such as flounder, perch, cod, herring, and anchovy, are in the bays and estuaries. Crab and ghost shrimp are also abundant in the estuaries. Anadromous fish such as coho, chum, and Chinook salmon, steelhead trout, and sea-run cutthroat trout use the perennial streams for spawning. Sturgeon are common in the Columbia River.

The beaches along the coast in map unit 3 provide habitat for razor clams. The habitat is affected by shifting ocean currents and winter storms.

Dune zone.-This zone consists of the areas on dunes and in interdunal swales of general soil map unit 3. Wetland plants are associated with the swamps and marshes of the interdunal swales. Along the, younger dunes, the plant community is influenced by beachgrass, Scotch-broom, and shore pine plantings. Conifers, shrubs, and herbaceous plants are native on the older stable dunes, and many of the dunes are in pasture that provides food for wildlife. Ducks, geese, beaver, and muskrat are common in the wet interdunal areas. There are some deer along the dunes. Other wildlife include moles, gophers, many varieties of songbirds, and a few pheasants.

Terrace zone.-This zone consists of the areas on terraces in general soil map units 2 and 7. The native vegetation consists of conifers, hardwoods, shrubs, and herbaceous plants and of rushes and sedges in the wetter areas. Many areas have been cleared and planted with pasture. Elk and deer feed on the pasture and use the surrounding woodlands for cover. Moles, gophers, and shrews are common. in the areas of pasture. Hawks and songbirds are common in this zone.

Mountain zone.-This zone consists of general soil map units 4, 5, 8, 9, 10, and 11. The soils in this zone are used for timber production. Clearcutting is the dominant method of timber harvest. Conifers dominate the timber stands, which have variable amounts of understory plants. After clearcutting, successional stages of herbaceous plants; shrubs, and hardwoods dominate the areas. Browse for elk and deer is more readily available in clearcut areas. Clearcut areas that are surrounded by trees provide the best habitat for elk and deer.

Poor management of timber harvesting in this zone can have a detrimental effect on streams used for spawning by anadromous fish. Extremes in streamflow, water temperature, debris dams, and siltation effect spawning streams. Other wildlife common to this zone include black bear, cougar, bobcat, coyote, porcupine, rabbits, squirrels, mountain beaver, snakes, and salamanders. Bird species include hawks, owls, ruffed grouse, band-tailed pigeon, doves, jays, crows, woodpeckers, and other songbirds.

Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by enhancing the natural establishment of desired plants.

Several wildlife refuges have been established in the survey area to preserve and enhance habitat for various species. Many of the islands in the Columbia River are in the Lewis and Clark National Wildlife Refuge (15,160 acres). Tenasillahe Island, about 2,000 acres, is part of the Columbian White-tailed Deer National Wildlife Refuge. The Jewell Wildlife Area, about 1,150 acres, is managed by the Oregon Fish and Wildlife Department. Fort Stevens State Park, Saddle Mountain State Park, and Ecola State Park are sanctuaries for many wildlife species:

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt

fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

The information in the tables, along with the soil maps and soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

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

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

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

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a consolidated layer, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

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

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of good indicates that soil properties and site features are favorable for the use

and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and poor indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a consolidated layer, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and consolidated layers can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

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

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

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

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

Construction Materials

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

construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

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

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

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

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

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

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

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

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

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

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

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

Water Management

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

This table also gives for each soil the restrictive features that affect drainage and irrigation.

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

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

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

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

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

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

Soil Properties

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

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

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

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

Engineering Index Properties

Table 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower .boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (1) and the Unified soil classification system (2).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can-have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points)

across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 13 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume (6). Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1 /3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are low, a change of less than 3 percent; moderate, 3 to 6 percent; and *high,* more than 6 percent. *Very high,* greater than 9 percent, is sometimes used.

Erosion factor *K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons pet acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

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

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

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

Soil and Water Features

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

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

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

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

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, 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.

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

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

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

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a ,lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. The first numeral in the range indicates the maximum rise of the water table in relation to the surface of the soil. The second numeral indicates the minimum depth in relation to the surface. Any numerical value preceded by a plus sign indicates the water table rises above the surface.

Table 15 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

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

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing.

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

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

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (19). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 16 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (*Fluv*, meaning influenced by flooding, plus *aquent* the suborder of the Entisols that have an aquic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties-and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, acid, mesic Typic Fluvaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (18). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (19). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alstony Series

The Alstony series consists of deep, well drained soils in mountainous areas. These soils formed in colluvium derived from igneous rock. Slopes are 3 to 90 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of Alstony gravelly loam, 3 to 30 percent slopes; Shingle Mill Road to Road 196, in the SE1/4SW1/4SW1/4 of sec. 31, T. 8 N., R. 6 W., Willamette Meridian:

O-2 inches to 0; moss, needles, twigs, and leaves.
A-0 to 7 inches; dark reddish brown (5YR 3/2) gravelly loam, reddish brown (5YR 5/3) dry; strong fine

granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; many very fine irregular pores; 30 percent gravel; very strongly acid; clear wavy boundary.
Bw1-7 to 17 inches; reddish brown (5YR 4/3) very gravelly loam, reddish brown (5YR 5/3) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and medium roots; many very fine and fine tubular pores; 35 percent gravel and 10 percent cobbles; very strongly acid; clear wavy boundary.
Bw2-17 to 33 inches; reddish brown (5YR 4/4) very gravelly loam, reddish brown (5YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine roots; many very fine and fine tubular pores; 35 percent gravel and 15 percent cobbles; very strongly acid; gradual smooth boundary.
Bw3-33 to 47 inches; reddish brown (5YR 4/4) very gravelly loam, reddish brown (5YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine and very fine tubular pores; 40 percent gravel and 20 percent cobbles; very strongly acid; gradual wavy boundary.
C-47 to 53 inches; dark brown (7.5YR 3/4) extremely cobbly loam, brown (7.5YR 5/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; 45 percent gravel and 30 percent cobbles; very strongly acid; abrupt wavy boundary.
R-53 inches; basalt.

The mean annual soil temperature is 47 to 52 degrees F. The depth to bedrock is 40 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist and 3 or 4 when dry. It is 12 to 18 percent clay and 15 to 30 percent gravel.

The B horizon has hue of 5YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It is 18 to 27 percent clay. It is 30 to 50 percent gravel and 5 to 20 percent cobbles.

The C horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It is 18 to 27 percent clay. It is 30 to 45 percent gravel and 20 to 35 percent cobbles.

Anunde Series

The Anunde series consists of very deep, well drained soils in mountainous areas. These soils formed in colluvium mixed with ash. Slopes are 3 to 30 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air-temperature is 47 to 51 degrees F.

Typical pedon of Anunde silt loam, 3 to 30 percent slopes, in an area of cutover woodland, 300 feet west of Shingle Mill Road, in the NW1/4NE1/4NW1/4 of sec. 29, T. 8 N., R. 6 W., Willamette Meridian:

O-1 inch to 0; leaves, needles, twigs, and moss.
A-0 to 7 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; moderate very fine subangular blocky structure and moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine roots; many fine and medium irregular pores; 10 percent soft nodules; very strongly acid; clear wavy boundary.
AB-7 to 18 inches; dark brown. (7.5YR 3/4) silt loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine and very fine roots; many fine and medium irregular pores; 5 percent soft nodules; very strongly acid; gradual wavy boundary.
Bw1-18 to 30 inches; brown (7.5YR 4/4) silt loam, light brown (7.5YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable; slightly sticky and slightly plastic; weakly smeary; common fine and medium roots; many fine irregular pores; very strongly acid; clear wavy boundary.
Bw2-30 to 53 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine roots; common fine irregular and tubular pores; very strongly acid; gradual wavy boundary.
Bw3-53 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; few fine roots; common very fine tubular pores; 10 percent gravel; extremely, acid.

The mean annual soil temperature is 48 to 52 degrees F. The solum is more than 60 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 to 4 moist or dry. It is 0 to 5 percent basalt gravel and 12 to 16 percent clay.

The Bw2 horizon has hue of 7.5YR or 10YR, value of 4 to 6 when moist and 6 or 7 when dry, and chroma of 3 to 6 when moist and 6 to 8 when dry. It is 2 to 15 percent basalt gravel and 18 to 25 percent clay.

The Bw3 horizon has hue of 7.5YR or 10YR, value of 4 to 6 when moist and 6 or 7 when dry, and chroma of 3 to 6 when moist and 6 to 8 when dry. It is 5 to 15 percent basalt gravel and 27 to 30 percent clay.

Ascar Series

The Ascar series consists of moderately deep, well drained soils in mountainous areas. These soils formed in mixed colluvium. Slopes are 30 to 90 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of an Ascar extremely gravelly loam in an area of Ascar-Rock outcrop complex, 60 to 90 percent slopes; 8 miles southeast of Seaside, about 200 feet north of a logging road in the SE1/4NW1/4NE1/4 of sec. 15, T. 5 N., R. 9 W., Willamette Meridian:

O-2 inches to 0; leaves, twigs, roots, and woody material.
A-0 to 12 inches; dark reddish brown (5YR 3/2) extremely gravelly loam, dark brown (7.5YR 4/4) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 65 percent gravel and 10 percent cobbles; very strongly acid; gradual wavy boundary.
Bw-12 to 35 inches; dark reddish brown (5YR 3/4) extremely gravelly loam, brown (7.5YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine irregular pores; about 50 percent gravel and 15 percent cobbles; very strongly acid; abrupt smooth boundary.
R-35 inches; basalt breccia.

The mean annual soil temperature is 47 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 15 inches thick. Depth to basalt is 20 to 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry. It is 55 to 70 percent gravel and 5 to 15 percent cobbles. The content of clay is 10 to 15 percent.

The Bw horizon has hue of 5YR or 7.5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 4 to 6 when moist or dry. It is 40 to 60 percent gravel and 10 to 20 percent cobbles. The content of clay is 12 to 18 percent:

Bergsvik Series

The Bergsvik series consists of very deep, very poorly drained organic soils in depressional areas between coastal dunes and between the dunes and the adjacent hills. These soils formed in partially decomposed wood and herbaceous plant material underlain by sand. Slopes are 0 to 1 percent. The mean annual precipitation is 70 to 100 inches, and the mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Bergsvik mucky peat, 0 to 1 percent slopes, 0.3 mile south on Hawkins Road from its intersection with Cullaby, Lake Road, about 75 feet west of road in the NE1/4SE1/4NW1/4 of sec. 15, T. 7 N., R. 10 W., Willamette Meridian:

O-2 inches to 0; leaves, twigs, moss, roots, and other woody material.
Oe1-0 to 4 inches; dark reddish brown (5YR 3/2, broken) mucky peat, dark reddish brown (5YR 2/2, rubbed and pressed); about 45 percent fibers, 20 percent rubbed; many very fine and fine roots; extremely acid; clear smooth boundary.
Oe2-4 to 15 inches; black (5YR 2/1, broken or rubbed and pressed) mucky peat; about 85 percent fibers, 40 percent rubbed; many very fine and fine roots; extremely acid; gradual smooth boundary.
Oe3-15 to 32 inches; very dark grayish brown (10YR 3/2, broken) mucky peat, black (10YR 2/1, rubbed and pressed); black (10YR 2/1) coatings; about 80 percent fibers, 40 percent rubbed; common very fine and fine roots; few wood fragments 1 to 2 inches in diameter; extremely acid; clear smooth boundary.
Oe4-32 to 36 inches; black (10YR 2/1 broken or rubbed and pressed) mucky peat; about 50 percent fibers, 30 percent rubbed; 40 percent mineral material; massive; slightly sticky and slightly plastic; common very fine roots; extremely acid; abrupt smooth boundary.
2C1-36 to 43 inches; very dark brown (7.5YR 2/2) fine sand, dark brown (7.5YR 3/2) dry; single grain; loose, nonsticky and nonplastic; few fine roots; very strongly acid; gradual smooth boundary.
2C2-43 to 60 inches; very dark grayish brown (2.5Y 3/2) fine sand, grayish brown (2.5Y 5/2) dry; single grain; loose, nonsticky and nonplastic; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to the underlying sand is 18 to 51 inches.

The surface tier has hue of 5YR or 10YR, value of 2 or 3, and chroma of 1 to 3 when moist. Fiber content ranges from 35 to 85 percent unrubbed and 15 to 40 percent rubbed. A mantle of sand 3 to 12 inches thick overlies the organic material in some areas.

The subsurface tier has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3 when moist, and chroma of 1 to 3 when moist. Fiber content ranges from 40 to 80 percent unrubbed and 20 to 50 percent rubbed. The lower part is 0 to 45 percent mineral material.

The 2C horizon has hue of 7.5YR or 2.5Y, value of 2 to 4 when moist and 3 to 6 when dry, and chroma of 1 or 2 when moist or dry.

Brallier Series

The Brallier series consists of very deep, very poorly drained organic soils on flood plains and in depressional areas between coastal dunes and toe slopes. These soils formed in partially decomposed herbaceous and woody plant material. Slope is 0 to 1 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Brallier mucky peat, 0 to 1 percent slopes, in an area of native vegetation; about 100 feet, south of Snyder's Bridge, over the Skipanon River; 50 feet east of road between sec. 33 and 34, T. 8 N.; R. 10 W., Willamette Meridian:

Oe1-0 to 26 inches; very dark grayish brown (10YR 3/2, broken or rubbed and pressed) mucky peat; about 70 percent fibers, 20 percent rubbed; many fine and medium roots; very strongly acid; gradual smooth boundary.
Oe2-26 to 40 inches; dark brown (10YR 3/3, broken) mucky peat, very dark brown (10YR 2/2, rubbed and pressed); about 80 percent fibers, 30 percent rubbed; common fine and medium roots; very strongly, acid; gradual smooth boundary.
Oe3--40 to 60 inches; dark brown (10YR 3/3, broken) mucky peat, very dark grayish brown (10YR 3/2, rubbed and pressed); about 95 percent fibers, 35 percent rubbed; few fine and medium roots; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. These soils are very strongly acid or extremely acid. Fibers are primarily herbaceous but fibers from roots, limbs, and logs are scattered throughout the control section in some pedons.

The surface tier has hue of 10YR to 5YR, value of 2 or 3 when moist, and chroma of 1 to 3 when moist. Fiber content is 25 to 75 percent unrubbed to less than 10 percent rubbed. A mantle of fine sand 3 to 12 inches thick overlies the organic material in some pedons.

The subsurface tier has hue of 10YR to 5YR. It has value of 3 and chroma of 3 or 4 moist when undisturbed and value of 2 or 3 and chroma of 2 when rubbed. Fiber content is 35 to 100 percent when undisturbed and 15 to 40 percent when rubbed.

The bottom tier has hue of 10YR to 5YR. It has value of 3 or 4 when moist and chroma of 3 or 4 when unrubbed and value of 3 when moist and chroma of 2 to 4 when rubbed. The organic material is hemic to fibric.

Braun Series

The Braun series consists of moderately deep, well drained soils on mountains. These soils formed in colluvium. Slopes are 3 to 90 percent. The mean annual precipitation is about 60 to 80 inches: The mean annual air temperature is about 45 to 51 degrees F.

Typical pedon of Braun silt loam, 30 to 60 percent slopes, in an area of woodland, about 300 feet northeast of road along the North Fork of Wolf Creek, in the NW1/4NE1/4SE1/4 of sec. 35, T. 4 N., R. 6 W., Willamette Meridian:

O-1 inch to 0; needles, twigs, roots, and leaves.
A-0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common coarse roots; many very fine irregular pores; 10 percent soft siltstone gravel; strongly acid; clear smooth boundary.
BA-3 to 9 inches; dark yellowish brown (10YR 4/4) silt loam, pale brown (10YR 6/3) dry; moderate very fine granular and subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine irregular pores; 10 percent soft siltstone gravel; very strongly acid; gradual wavy boundary.
Bw1-9 to 20 inches; brown (7.5YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; 25 percent soft siltstone gravel; very strongly acid; gradual wavy boundary.
Bw2-20 to 29 inches; strong brown (7.5YR 4/6) silt loam, light yellowish brown (10YR 6/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; 30 percent soft siltstone gravel; very strongly acid; gradual wavy boundary.
Bw3-29 to 35 inches; strong brown (7.5YR 5/6) silt loam, pink (7.5YR 7/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; 15 percent soft siltstone gravel; very strongly acid; abrupt smooth boundary.
Cr-35 inches; fractured siltstone.

The mean annual soil temperature is 47 to 52 degrees F. The profile is very strongly acid to medium acid. Depth to the paralithic contact is 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. It is 14 to 18 percent clay and 5 to 15 percent soft siltstone gravel.

The BA horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 to 4 when moist or dry. It is 18 to 25 percent clay. It is 5

to 25 percent soft siltstone gravel and 0 to 15 percent soft siltstone cobbles.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 3, 4, or 6 when moist or dry. It is 18 to 25 percent clay. It is 5 to 40 percent soft siltstone gravel and 0 to 25 percent soft siltstone cobbles.

Brenner Series

The Brenner series consists of very deep, poorly drained soils on nearly level flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Brenner silt loam, 0 to 3 percent slopes, in an area of tussock, skunkcabbage, and sedges, 75 feet west of powerline that runs north and south on the west side of the Necanicum River, in the SE1/4NW1/4 of sec. 33, T. 6 N., R. 10 W., Willamette Meridian:

Ap-0 to 10 inches; dark brown (10YR 3/2) silt loam, brown (10YR 5/2) dry; few fine prominent yellowish red (5YR 4/6) mottles and few fine faint grayish brown (10YR 5/1) mottles; moderate fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine roots; common medium irregular pores; very strongly acid; clear smooth boundary.

Bg1-10 to 12 inches; grayish brown (10YR 5/2) silty clay loam, light gray (10YR 7/2) dry; many medium prominent yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard; friable to firm, sticky and plastic; many fine roots; common medium irregular pores; very strongly acid; clear wavy boundary.

Bg2-12 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (10YR 7/2) dry; many medium prominent yellowish red (5YR 5/8, 4/6) and strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; hard, friable to firm, sticky and plastic; few fine roots; common medium irregular pores; very strongly acid; clear wavy boundary.

Bg3-22 to 30 inches; grayish brown (t0YR 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; common medium prominent reddish yellow (7.5YR 6/8) mottles; weak medium and coarse subangular blocky structure; hard, friable to firm, sticky and plastic; few fine roots; common medium irregular pores; very strongly acid; clear wavy boundary.

Cg1-30 to 45 inches; greenish gray (5BG 5/1) silty clay loam, light brownish gray (2.5Y 6/2) dry; few medium prominent strong brown (7.5YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; common very fine tubular pores; strongly acid; clear wavy boundary.

Cg2-45 to 60 inches; greenish gray (5BG 5/1) silty clay loam, pale olive (5Y 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; common very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Soil depth is more than 60 inches, but rooting depth is limited by the seasonal water table. The solum is strongly acid or extremely acid.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. Mottles are faint to prominent. The horizon is 20 to 27 percent clay.

The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5 when moist and 5 to 7 when dry, and chroma of 1 or 2 when moist or dry. Chroma of 1 when moist is below a depth of 30 inches. The horizon has distinct to prominent mottles. It is 18 to 30 percent clay.

The C horizon has hue of 5BG to 10YR, value of 3 to 5 when moist and 4 to 7 when dry, and chroma of 2 to neutral when moist or dry. It is silty clay or silty clay loam and is 27 to 45 percent-clay. Thin lenses of coarser textured material are in some pedons.

Caterl Series

The Caterl series consists of deep, well drained soils in mountainous areas. These soils formed in mixed colluvium. Slopes are 3 to 90 percent. The mean annual precipitation is 80 to 100 inches. The mean annual air temperature is 41 to 45 degrees F.

Typical pedon of a Caterl gravelly silt loam, in an area of Caterl-Laderly complex, 3 to 30 percent slopes, west -of a curve in logging road on big clearcut, in the SE1/4NE1/4 of sec. 12, T. 4 N., R. 7 W., Willamette Meridian:

O1-1 inch to 0; needles, leaves, twigs, and moss.

A1-0 to 5 inches; dark brown (7.5YR 3/2) gravelly silt loam, brown (7.5YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly smeary; many very fine and fine roots; many fine irregular pores; about 20 percent hard gravel; extremely acid; gradual wavy boundary.

A2-5 to 12 inches; dark brown (7.5YR 3/3) gravelly silt loam, brown (7.5YR 5/3) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly smeary; many very fine and fine roots; many fine irregular pores; about 20 percent hard gravel; extremely acid; clear wavy boundary.

Bw1-12 to 21 inches; brown (7.5YR 5/4) gravelly loam, reddish yellow (7.5YR 7/6) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine tubular pores; 20 percent hard gravel; extremely acid; gradual smooth boundary.

Bw2-21 to 28 inches; brown (7.5YR 4/4) gravelly loam, light brown (7.5YR 6/4) dry; massive; soft, very friable, nonsticky and nonplastic; few fine roots; common fine tubular pores; 70 percent gravel; extremely acid; clear wavy boundary.

C-28 to 43 inches; reddish brown (5YR 4/4) extremely gravelly silt loam, reddish brown (5YR 5/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; 45 percent basalt gravel and 20 percent basalt gravel; medium acid; gradual wavy boundary.

R-43 inches; basalt.

The mean annual soil temperature is 42 to 46 degrees F. The umbric epipedon is 10 to 20 inches. Depth to basalt is 40 to 60 inches. The weighted average rock fragment content is 35 to 80 percent in the textural control section.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when ,moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. It is 15 to 18 percent clay.)t is 15 to 30 percent hard gravel and 0 to 10 percent cobbles.

The Bw horizon has hue of 5YR or 7.5YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 4 or 6 when moist or dry. It is 18 to 22 percent clay. It is 20 to 45 percent hard gravel and 0 to 10 percent cobbles.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. It is 12 to 18 percent clay. It is 50 to 70 percent gravel and 0 to 10 percent cobbles.

Chitwood Series

The Chitwood series consists of very deep, somewhat poorly drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 15 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Chitwood silt loam, 0 to 7 percent slopes, in ah area of pasture, about 500 feet east of Lewis and Clark Road, in the SE1/4SE1/4SW1/4 of sec. 17, T. 7 N., R. 9 W., Willamette Meridian:

Ap-0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine irregular pores; extremely acid; gradual smooth boundary.

BA-7 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many fine irregular pores; very strongly acid; clear wavy boundary.

Bw1-11 to 22 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common medium prominent yellowish brown (10YR 5/8) mottles; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many fine tubular pores; extremely acid; gradual wavy boundary.

Bw2-22 to 34 inches; brown (10YR 5/3) silty clay, pale brown (10YR 6/3) dry; many medium distinct gray (10YR 5/1) mottles and many medium prominent yellowish brown (10YR 5/8) and yellowish red (5YR 5/6) mottles; moderate coarse prismatic structure; hard, firm, sticky and plastic; common very fine and fine roots; many very fine tubular pores; extremely acid; gradual wavy boundary.

Bw3-34 to 50 inches; light olive brown (2.5Y 5/4) silty clay, light brownish gray (2.5Y 6/2) dry; many medium prominent gray (10YR 5/1), yellowish red (5YR 5/8), and yellowish brown (10YR 5/8) mottles; moderate coarse prismatic structure; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; extremely acid; clear wavy boundary.

BC-50 to 60 inches; variegated yellowish brown (10YR 5/8), yellowish red (5YR 5/8), gray (10YR 5/1); and light olive brown (2.5Y 5/4) silty clay; weak coarse prismatic structure; hard, firm, sticky and plastic; few fine roots; few very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick.

The Ap and BA horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 20 to 27 percent.

The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5 when moist and 4 to 6 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 35 to 45 percent. Mottles that have chroma of 1 or 2 when moist are between depths of 20 and 30 inches.

The BC horizon has hue of 10YR to, 5Y, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 to 8 when moist or dry. The content of clay is 35 to 45 percent.

Clatsop Series

The Clatsop series consists of very deep, very poorly drained soils on flood plains influenced by tides. These soils formed in alluvium. Slopes are 0 to 1 percent. The

mean annual air temperature is 48 to 51 degrees F. The mean annual precipitation is 70 to 100 inches.

Typical pedon of a Clatsop muck in an area of Coquille-Clatsop complex, 0 to 1 percent slopes, 100 feet north of railroad tracks, in the SE1/4SE1/4SE1/4 of sec. 17, T. 8 N., R. 8 W., Willamette Meridian:

Oa-0 to 6 inches; very dark grayish brown (2.5Y 3/2) muck, light brownish gray (2.5Y 6/2) dry; weak very fine granular structure; friable; many very fine and fine roots; many very fine irregular pores; slightly acid; gradual smooth boundary.

Ag-6 to 13 inches; very dark grayish brown (2.5Y 3/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; slightly acid; clear smooth boundary.

Cg-13 to 24 inches; dark gray (5Y 4/1) silt loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

2Cg-24 to 60 inches; very dark gray (5Y 3/1) silt loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; neutral.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The soil is usually saturated and is inundated by high tides unless protected by dikes or levees. Depth to the 2Cg horizon is less than 35 inches. In uncultivated areas the histic epipedon is 5 to 10 inches thick and is 50 to 70 percent organic matter. Where diked and drained, the soil generally is extremely acid to very strongly acid, but in some areas it is strongly acid or medium acid below a depth of 40 inches. Where not diked and drained, the soil is medium acid to neutral.

The Oa and Ag horizons have hue of 10YR or 2.5Y, value of 3 to 6 when moist and 5 or 6 when dry, and chroma of 1 to 3 when moist or dry. The Oa horizon is muck or mucky peat, and it has weak granular structure or weak subangular blocky structure or is massive. Fiber content is 5 to 45 percent unrubbed and 0 to 20 percent rubbed. The Ag horizon is silt loam or silty clay loam and is 20 to 35 percent clay. It has weak subangular blocky structure or is massive.

The Cg horizon, has hue of 10YR, 2.5Y, or 5Y, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 1 or less when moist or dry. The content of clay is 20 to 35 percent. Thin lenses of peat, muck, or sand are in some pedons.

The 2Cg horizon has hue of 5Y or neutral, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 1 or less when moist or dry. The content of clay is 20 to 35 percent. Thin lenses of fine or medium sand are in some pedons. Fine sand is below a depth of 40 inches in some pedons. Buried logs and material from aquatic plants are common in the Cg and 2Cg horizons.

Coquille Series

The Coquille series consists of very deep, very poorly drained soils on flood plains influenced by tides. These soils formed in alluvium. Slope is 0 to 1 percent. The mean annual air temperature is 4.8 to 51 degrees F. The mean annual precipitation is 70 to 100 inches.

Typical pedon of a Coquille silt loam in an area of Coquille-Clatsop complex, 0 to 1 percent slopes, in an area of native vegetation; about 175 feet northeast of boat ramp slough; in the SE1/4SW1/4NW1/4 of sec. 13, T. 8 N., R. 9 W., Willamette Meridian:

A-0 to 6 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; . many very fine irregular pores; medium acid; clear smooth boundary.

C1-6 to 16 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; many fine distinct dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine roots; many very fine tubular pores; medium acid; clear smooth boundary.

C2-16 to 30 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; many fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; medium acid; clear smooth boundary.

2Cg-30 to 60 inches; dark gray (5Y 4/1) silt loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard, friable, slightly sticky and-slightly plastic; common very fine roots; many very fine tubular pores; slightly acid. '

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to the 2Cg horizon is 30 to 46 inches. Under natural conditions the soil is medium acid to neutral. When diked and drained, the soil generally is extremely acid or very strongly acid, but in some pedons it is strongly acid or medium acid below a depth of 40 inches.

The A horizon has hue of 2.5Y or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 1 or 2 when moist or dry. The clay content is 20 to 30 percent.

The C horizon has hue of 10YR to 5Y, value of 3 or 4 when moist and 6 or 7 dry, and chroma of 2 when moist or dry. It has common or many, distinct or prominent

mottles that have hue of 10YR or 5YR. It is silt loam or silty clay loam. The content of clay is 20 to 35 percent. Thin lenses of fibrous peat and sand are in some pedons.

The 2Cg horizon has hue of 2.5Y or 5Y, value of 3 or 4 when moist and 6 or 7 when dry, and chroma of 1 or less when moist and 2 or less when dry. The content of clay is 35 to 65 percent. Thin lenses of fine to coarse textured material and peat are in some pedons. Fine sand is below a depth of 40 inches in some pedons.

Coquille Variant

The Coquille Variant consists of very deep, poorly drained soils on protected tidal flats. These soils formed in alluvium. Slope is 0 to 1 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Coquille Variant silt loam, 0 to 1 percent slopes, about 100 feet west of paved driveway in the NW1/4NE1/4NE1/4 of sec. 21, T. 8 N., R. 10 W., Willamette Meridian:

Ap-0 to 4 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure parting to very fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; very strongly acid; clear smooth boundary.

AC-4 to 9 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/2) dry; many very fine distinct yellowish red (5YR 5/6) mottles; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.

C1-9 to 14 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; many fine distinct yellowish red (5YR 4/6) and dark reddish brown (5YR 3/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common fine and very fine tubular pores; extremely acid; clear smooth boundary.

C2-14 to 22 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; many fine and medium prominent dark reddish brown (5YR 2/2) mottles and many medium distinct yellow (10YR 7/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; extremely acid; abrupt smooth boundary.

Cg1-22 to 30 inches; grayish brown (10YR 6/1) silty clay loam, light gray (10YR 7/1); many fine prominent dark reddish brown (5YR 2/2) mottles; massive; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; extremely acid; gradual smooth boundary.

Cg2-30 to 35 inches; dark gray (10YR 4/1) sandy clay loam, gray (10YR 6/1) dry; few fine distinct dark yellowish brown (10YR 3/6) mottles; massive; hard, firm, sticky and plastic; few very fine roots; very strongly acid; clear smooth boundary.

2Cg1-35 to 45 inches; dark gray (10YR 4/1) fine sand, gray (10YR 6/1) dry; many fine and medium prominent dark reddish brown (5YR 3/4) mottles; single grain; loose; extremely acid; gradual smooth boundary.

2Cg2-45 to 60 inches; very dark grayish brown (10YR 3/2) fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose; medium acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to the 2Cg horizon is 20 to 40.inches.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry. The content of clay is 18 to 25 percent.

The C and Cg horizons have hue of 10YR or 2.5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 1 to 3 when moist or dry. Chroma of 1 when moist is below a depth of 30 inches. The content of clay is 20 to 35 percent.

The 2Cg horizon has hue of 10YR to 5Y, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 1 or 2 when moist or dry. The content of clay is 3 to 5 percent.

Croquib Series

The Croquib series consists of very deep, poorly drained soils on stream terraces. These soils formed in mixed alluvium over weakly to strongly consolidated alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air , temperature is 48 to 51 degrees F.

Typical pedon of Croquib silt loam, 0 to 3 percent slopes, in an area of pasture; about 300 feet east of house and 25 feet south of road in the SE1/4NW1/4NE1/4 of sec. 18, T. 7 N., R. 9 W., Willamette Meridian:

Ap1-0 to 2 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; few fine prominent yellowish brown (10YR 5/8) mottles; moderate very fine granular and subangular blocky structure; slightly hard, friable, slightly sticky and slightly, plastic; weakly smeary; many very fine roots; many very fine irregular pores; very strongly acid; clear smooth boundary.

Ap2-2 to 6 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; common fine arid medium prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard,

friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; many very fine tubular pores; extremely acid; abrupt smooth boundary.
Bw1-6 to 13 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; many medium prominent reddish yellow (7.5YR 6/8) mottles and many medium faint light brownish gray (10YR 6/2) mottles; moderate medium prismatic structure; hard, firm, sticky and plastic; weakly smeary; common very fine roots; many very fine tubular pores; extremely acid; clear smooth boundary.
Bw2-13 to 24 inches; light brownish gray (10YR 6/2) silty clay loam, light gray (10YR 7/2) dry; many fine prominent strong brown (7.5YR 5/8) mottles and common fine faint dark grayish brown (10YR 4/2) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; hard, firm, sticky and plastic; weakly smeary; few very fine roots; common very fine tubular pores; extremely acid; gradual smooth boundary.
Bw3-24 to 34 inches; light brownish gray (1.0YR 6/2) silty clay loam, light gray (10YR 7/2) dry; many fine and medium prominent strong brown (7.5YR 5/8) mottles and few fine faint dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; few very fine roots; common very fine tubular pores; extremely acid; clear wavy boundary.
2C-34 to 60 inches; light brownish gray (10,YR 6/2) extremely gravelly loam, light gray (10YR 7/2) dry; many fine and medium prominent strong brown (7.5YR 5/8) mottles; massive; strongly consolidated; very hard, very firm; 60 percent gravel and 10 percent cobbles; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to the 2C horizon is 25 to 40 inches.

The A or Ap horizon has value of 2 or 3 when moist and 3 or 4 when dry, and it has chroma of 1 or 2 when moist or dry. It is 15 to 25 percent clay.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 when moist and 5 to 7 when dry, and chroma of 1 or 2 when moist or dry. It is 27 to 35 percent clay.

The 2C horizon has hue of 10YR or 2.5Y, value of 6 or 7 when moist and 7 or 8 when dry, and chroma of 2 when moist or dry. It is weakly to strongly consolidated. It Is 40 to 65 percent gravel and 5 to 15 percent cobbles. It is 15 to 25 percent clay.

Ecola Series

The Ecola series consists of moderately deep, well drained soils on mountains. These soils formed in colluvium derived dominantly from sedimentary rock. Slopes are 3 to 90 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 51 degrees F.

Typical pedon of an Ecola silt loam in an area of Templeton-Ecola silt loams, 30 to 60 percent slopes, in an area of woodland; at the junction of the Crown Zellerbach Mainline II and Lewis and Clark crossover roads, in the SE1/4SW1/4 of sec. 2, T. 7 N., R. 10 W., Willamette Meridian:

O1-3 inches to 0; twigs, moss, and roots.
A-0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; strong fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine, medium, and coarse roots; many very fine, fine, and medium irregular pores; common fine concretions; strongly acid; clear smooth boundary.
AB-7 to 16 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine irregular pores; few fine and medium siltstone and shale fragments; strongly acid; clear smooth boundary.
Bw-16 to 33 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate fine subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; many very fine tubular pores; few fine and medium siltstone and shale fragments; very strongly acid; clear wavy boundary.
C-33 to 37 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; massive; hard, firm, sticky and plastic; 60 percent fine and medium weathered siltstone and shale fragments; very few fine roots; many fine tubular pores; strongly acid; clear wavy boundary.
Cr-37 inches; weathered siltstone.

The mean annual soil temperature is 47 to 52 degrees F. The difference between the mean winter and mean summer soil temperature is less than 9 degrees. Depth to the paralithic contact is 20 to 40 inches. The umbric epipedon is 14 to 20 inches thick. The textural control section is less than 15 percent sand that is coarser than very fine sand.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 1.8 to 25 percent.

The Bw horizon has value of 3 or 4 when moist and 4 to 6 when dry, and it has chroma of 3 or 4 when moist or dry. The content of clay is 22 to 35 percent. The content of soft siltstone fragments is 5 to 30 percent.

The C horizon has value of 4 or 5 when moist and 5 or 6 when dry, and it has chroma of 4 or 6 when moist

or dry**.** The content of clay is 22 to 35 percent. The content of soft siltstone fragments is 10 to 60 percent.

Eilertsen Series

The Eilertsen series consists of very deep, well drained soils on stream terraces. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Eilertsen silt loam, 0 to 3 percent slopes, about 1,750 feet north and 650 feet east of the southwest corner of sec. 23, T. 6 N., R. 6 W., Willamette Meridian:

O1-1 inch to 0; decaying grass.
Ap-0 to 7 inches; very dark brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine irregular pores; very strongly acid; cleat smooth boundary.
A2-7 to 18 inches; very dark brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots and common fine roots; many fine tubular pores; very strongly acid; clear smooth boundary.
Bt-18 to 28 inches; dark yellowish brown (10YR 4/4) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots and common fine roots; many fine tubular pores; very strongly acid; clear smooth boundary.
2C1-28 to 42 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; massive; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; extremely acid; gradual wavy boundary.
2C2-42 to 60 inches; dark yellowish brown (10YR 4/4) silt loam, yellowish brown (10YR 5/4) dry; massive; hard, firm, sticky and plastic; very few fine roots; many very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 52 degrees F. The umbric epipedon is 10 to 20 inches thick. Depth to bedrock is more than 60 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. The content of clay is 12 to 20 percent.

The Bt horizon has value of 4 or 5 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. The content of clay is 18 to 35 percent.

The 2C horizon has value of 4 or 5 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. Mottles are below a depth of 40 inches in some pedons. The content of clay is 10 to 25 percent.

Elsie Series

The Elsie series consists of very deep, well drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 15 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Elsie silt loam, 0 to 7 percent slopes, in an area of woodland, about 50 feet north of Jewell Road, in the SW1/4NW1/4 of sec. 13, T. 5 N., R. 7 W., Willamette Meridian:

O-2 inches to 0; leaves, twigs, moss, and roots.
Al -0 to 7 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common medium irregular pores; extremely acid; clear smooth boundary.
A2-7 to 24 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; common fine and medium irregular pores; extremely acid; clear wavy boundary.
Bt1-24 to 34 inches; dark yellowish brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores and common fine irregular pores; few thin clay films in pores; extremely acid; clear wavy boundary.
Bt2-34 to 50 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; slightly hard, friable to firm, sticky and plastic; few fine roots; common very fine and fine tubular pores; few thin clay films on peds and in pores; extremely acid; gradual smooth boundary.
BC-50 to 62 inches; yellowish brown (10YR 5/4) loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine and very fine tubular pores; extremely acid.

The mean annual soil temperature. is 49 to 52 degrees F. Depth to bedrock is more than 60 inches. The umbric epipedon is 20 to 30 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 18 to 25 percent.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 to 6 when moist and 5 or 6 when dry, and chroma of 3

or 4 when moist or dry. The content of clay is 22 to 30 percent.

The BC horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 or 6 when dry. The content of clay is 18 to 27 percent.

Gearhart Series

The Gearhart series consists of very deep, somewhat excessively drained soils on stabilized sand dunes. These soils formed in eolian sand. Slope is 3 to 30 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Gearhart fine sandy loam, 3 to 15 percent slopes (fig. 14), in an area of native vegetation; on a stabilized dune 20 feet south of Camp Kiwanilong Road and about 500 feet southwest of its junction with the Fort Stevens Road; in the NW1/4SE1/4 of sec. 20, T. 8 N., R. 10 W., Willamette Meridian:

O-1 inch to 0; leaves, needles, moss, and twigs.
A-0 to 11 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine irregular pores; very strongly acid; abrupt smooth boundary.
Bw-11 to 16 inches; dark brown (7.5YR 3/3) loamy fine sand, brown (7.5YR 5/4) dry; weak fine subangular blocky structure parting to single grain; loose, nonsticky and nonplastic; common very fine roots; many very fine irregular pores; common reddish brown (2.5YR 4/4) streaks; very strongly acid; gradual irregular boundary.
C1-16 to 45 inches; dark gray (10YR 4/1) fine sand, light gray (10YR 6/1) dry; single grain; loose, nonsticky and nonplastic; many very fine irregular pores; few reddish brown (2.5YR 4/4) streaks; very strongly acid; diffuse wavy boundary.
C2-45 to 60 inches; gray (10YR 5/1) sand, light gray (10YR 6/1) dry; single grain; loose, nonsticky and nonplastic; many very fine irregular pores; very strongly acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 1 or 2 when moist or dry. The content of clay is 10 to 15 percent.

The Bw horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 3 to 5 percent. In some pedons a few iron stains that have hue of 2.5YR are on the peds.

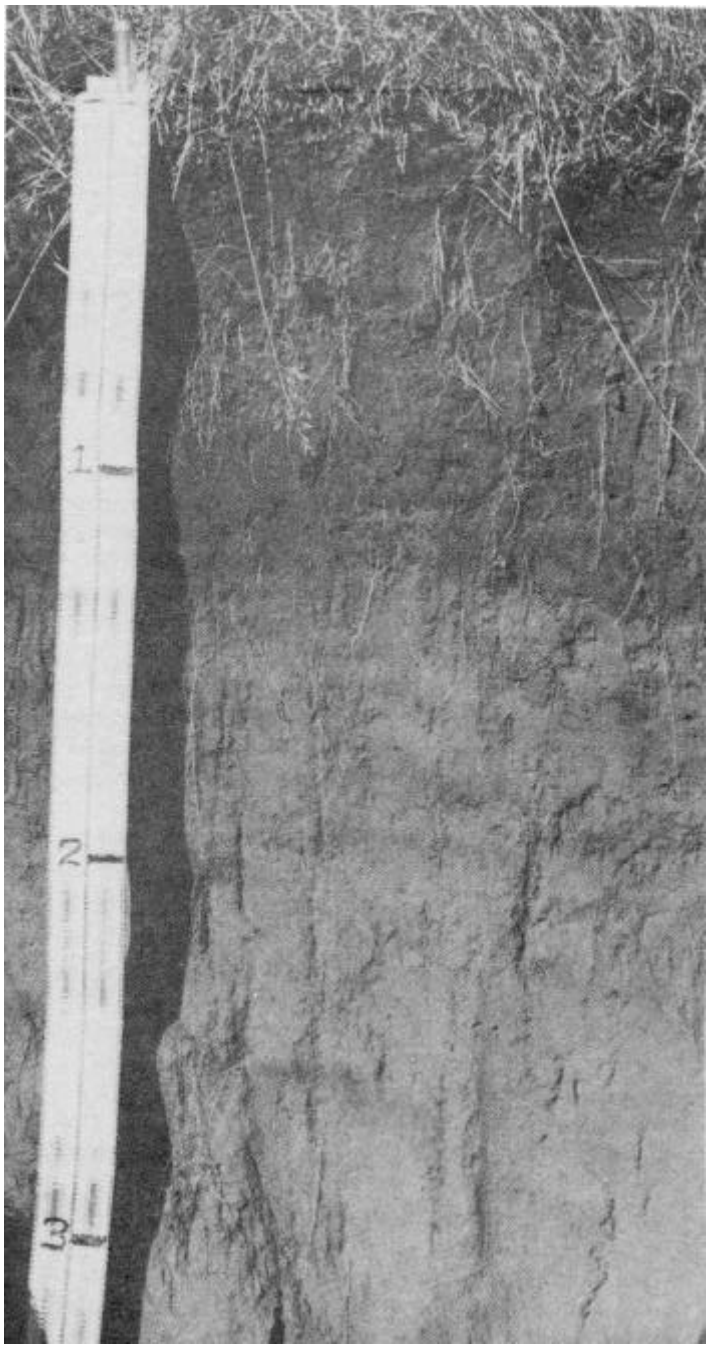

Figure 14.-Profile of Gearhart fine sandy loam, 3 to 15 percent slopes.

The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 1 to 4 when moist or dry. The content of clay is 3 to 5 percent.

Grindbrook Series

The Grindbrook series consists of deep and very deep, moderately well drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 30 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Grindbrook silt loam, 7 to 20 percent slopes, in a cutover area; about 300 feet northwest of road in- the NE1/4NE1/4SW1/4 of sec. 20, T. 7 N., R. 9 W., Willamette Meridian:

O-1 inch to 0; roots, moss, leaves, and twigs.
A1-0 to 10 inches; black (10YR 2/1) silt loam, dark brown (10YR 3/3) dry; moderate fine granular structure and moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular pores; extremely acid; clear wavy boundary.
A2-10 to 15 inches; very dark brown (10YR 2/2) silt loam, dark yellowish brown (10YR 4/3) dry; moderate fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine and very fine roots; many very fine tubular pores; extremely acid; clear wavy boundary.
BA-15 to 28 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.
Bw1-28 to 35 inches; brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; many medium faint yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine and medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; extremely acid; clear smooth boundary.
Bw2-35 to 60 inches; gray (10YR 6/1) silty clay loam, pale brown (10YR 6/3) dry; many prominent yellowish brown (10YR 5/6) mottles; strong fine subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 52 degrees. F. The difference between the mean summer and mean winter temperature is less than 9 degrees. Depth to bedrock is 40 to 60 inches or more. The umbric epipedon is 20 to 30 inches thick. The textural control section averages 25 to 35 percent clay.

The A horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 3 or 4 when moist or dry. The content of clay is 20 to 35 percent.

The Bw horizon has value of 4 to 7 when moist or dry, and it has chroma of 3 or 4 when moist or dry. It is silty clay loam to silty clay or clay. The content of clay is 30 to 45 percent.

Hapludalfs

Hapludalfs are deep, well drained to somewhat poorly drained soils on terraces and fans. These soils formed in mixed alluvium. Slopes are 0 to 15 percent. The mean precipitation is 60 to 90 inches. The mean annual air temperature is 48 to 51 degrees F.

Reference pedon of a Hapludalf silt loam in an area of Udifluvents-Hapludalfs complex, 0 to 15 percent slopes, about 200 feet east of Northrup Creek Road, in the NE1/4NE1/4SW1/4 of sec. 8, T. 6 N., R. 6 W., Willamette Meridian:

A1-0 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine irregular pores; very strongly acid; gradual smooth boundary.
A2-4 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; strong medium granular structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine tubular pores; very strongly acid; clear wavy boundary.
Bw-11 to 20 inches; dark yellowish brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine tubular pores; extremely acid; clear wavy boundary.
Bt1-20 to 32 inches; dark yellowish brown (10YR 4/4) silt loam, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common fine and medium roots; many very fine tubular pores; few thin clay films on ped faces and in pores; extremely acid; clear wavy boundary.
Bt2-32 to 44 inches; yellowish brown (10YR 5/4) loam, light yellowish brown (10YR 6/4) dry; common fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; common thin clay films on ped faces and in pores; extremely acid; clear wavy boundary.
C-44 to 60 inches; grayish brown (10YR 5/2) loamy fine sand, light gray (10YR 7/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles and many medium prominent strong brown (7.5YR 5/8) mottles; massive; soft, very friable, nonsticky and slightly plastic; very few very fine roots; common very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 53 degrees F. The depth to bedrock is 40 to 60 inches or more. The content of clay is 18 to 35 percent in the control section. The content of coarse fragments is 0 to 80 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 1 to 3 when moist or dry.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 4 to 6 when moist or dry. The content of clay is 15 to 30 percent.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist or dry, and chroma of 3 or 4 when moist or dry. Clay films range from few thin to common moderately thick. The content of clay is 20 to 95 percent.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. Mottles range from few faint to many prominent.

Harslow Series

The Harslow series consists of moderately deep, well drained soils on mountainsides. These soils formed in colluvium weathered from volcanic material. Slopes are 30 to 90 percent. The mean annual precipitation is 60 to 90 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of a Harslow very gravelly loam in an area of Harslow-Kilchis very gravelly loams, 60 to 90 percent slopes, in a forested area, on a steep slope 100 feet south of the road in the SE1/4NW1/4 of sec. 19, T. 4 N., R. 7 W., Willamette Meridian:

O-2 inches to 0; needles, leaves, twigs, and roots.
A-0 to 11 inches; dark brown (7.5YR 3/2) very gravelly loam, dark brown (7.5YR 4/3) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; many very fine irregular pores; about 35 percent gravel; strongly acid; clear smooth boundary.
BA-11 to 18 inches; dark brown (7.5YR 3/3) very gravelly loam, dark brown (7.5YR 4/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; many very fine irregular pores; about 35 percent gravel and 5 percent cobbles; very strongly acid; clear wavy boundary.
Bw-18 to 24 inches; brown (7.5YR 4/3) very cobbly loam, brown (7.5YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common very fine roots; common very fine irregular pores; about 20 percent gravel and 35 percent cobbles; very strongly acid; clear wavy boundary.
BC-24 to 34 inches; brown (7.5YR 4/3) extremely gravelly loam, brown (7.5YR 5/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common very fine roots; common very fine irregular pores; about 55 percent gravel and 15 percent cobbles; very strongly acid; clear wavy boundary.
R-34 inches; basalt.

The mean annual soil temperature is 47 to 51 degrees F. The depth to bedrock is 20 to 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. It is 35 to 45 percent gravel and 0 to 10 percent cobbles. It is 15 to 25 percent clay.

The BA horizon has hue of 5YR or 7.5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry. It is 35 to 45 percent gravel and 5 to 15 percent cobbles. It is 18 to 25 percent clay.

The Bw horizon has hue of 5YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, chroma of 3 or 4 when moist and 4 to 6 when dry. It is 20 to 50 percent gravel and 0 to 35 percent cobbles. It is 20 to 27 percent clay.

The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist and 4 or 6 when dry. It is 45 to 70 percent gravel and 0 to 20 percent cobbles. It is 15.to 25 percent clay.

Hebo Series

The Hebo series consists of very deep, poorly drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Hebo silty clay loam, 0 to 3 percent slopes, in an area of native vegetation, in the NW1/4NW1/4NW1/4 of sec. 3, T. 7 N., R. 9 W., Willamette Meridian:

A-0 to 5 inches; black (10YR 2/1) silty clay loam, very dark brown (10YR 2/2) dry; strong medium and fine granular structure; hard, friable, sticky and plastic; many fine and very fine roots; many very fine irregular pores; extremely acid; clear wavy boundary.
BA-5 to 11 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine faint very dark grayish brown (10YR 3/2) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many fine and very fine roots; common very fine tubular pores; extremely acid; clear wavy boundary.

Bg1-11 to 16 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; many medium prominent strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure; very hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; very strongly acid; clear wavy boundary.
Bg2-16 to 24 inches; gray (10YR 6/1) clay, light gray (10YR 7/1) dry; many medium prominent reddish yellow and strong brown (7.5YR 6/8, 5/8) mottles; strong medium prismatic structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; very strongly acid; clear wavy boundary.
Bg3-24 to 38 inches; gray (10YR 6/1) silty clay, light gray (10YR 7/1) dry; common medium distinct yellowish brown (10YR 5/8) mottles; strong fine angular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; very strongly acid; clear wavy boundary.
2Cg-38 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, light gray (10YR 7/1) dry; many fine and medium prominent yellowish red and reddish yellow (5YR 5/8, 6/8) mottles; massive; very hard, firm, sticky and plastic; few very fine tubular pores; extremely acid.

The mean annual soil temperature is 48 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to bedrock is more than 60 inches. The profile is extremely acid or very strongly acid.

The A and BA horizons have value of 2 or 3 when moist and 2 to 5 when dry, and they have chroma of 1 or 2 when moist or dry. It has few to many, faint to distinct mottles. It is silty clay loam or silty clay and is 27 to 45 percent clay.

The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 when moist and 5 to 7 when dry, and chroma of 1 or less when moist or dry. It has common to many, distinct to prominent mottles. It is silty clay or clay and is 40 to 60 percent clay.

The 2Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 when moist and 5 to 7 when dry, and chroma of 1 or 2 when moist or dry. It is silty clay loam or silty clay and is 35 to 45 percent clay.

Heceta Series

The Heceta series consists of very deep, poorly drained soils in interdunal depressional areas. These soils formed in dune sand. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of a Heceta fine sand in an area of Heceta-Waldport fine sands, 0 to 15 percent slopes, 0 to 3 percent slopes, in an area of brush and sedges, 30 feet north of road in the NE1/4SW1/4NE1/4 of sec. 29, T. 8 N., R. 10 W., Willamette Meridian:

O-2 inches to 0; mat of very fine and fine roots, leaves, twigs, moss, and lichens.
A-0 to 3 inches; very dark grayish brown (10YR 3/2) fine sand, light brownish gray (10YR 6/2) dry; single grain; loose; many very fine, fine, and medium roots; medium acid; clear wavy boundary.
C1-3 to 17 inches; grayish brown (2.5Y 5/2) fine sand, light gray (10YR 7/2) dry; common distinct medium brown (7.5YR 5/4) and light brownish gray (2.5YR 6/2) mottles; single grain; loose; many fine and medium roots; medium acid; clear wavy boundary.
C2-17 to 60 inches; gray (5Y 5/1) sand, light gray (5Y 7/1) dry; few prominent medium brown (7.5YR 5/4) mottles; single grain; loose; common fine roots; slightly acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The profile is slightly acid or medium acid throughout. Depth to bedrock is more than 60 inches.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 to 5 when moist and 5 to 7 when dry, and chroma of 1 to 3 when moist or dry.

The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 1 to 3 when moist or dry.

Hemcross Series

The Hemcross series consists of very deep, well drained soils on mountains. These soils formed in colluvium weathered from volcanic material. Slopes are 3 to 60 percent. The mean annual precipitation is 60 to 90 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of Hemcross silt loam, 3 to 30 percent slopes, in a forested area, 200 feet above spur road west of Nettle Creek Road, in the SE1/4NW1/4 of sec. 30, T. 5 N., R. 6 W.; Willamette Meridian:

O-2 inches to 0; leaves, needles, moss, roots, and twigs.
A1-0 to 7 inches; dark brown (7.5YR 3/2) silt loam, brown (10YR 5/3) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine and medium roots; many very fine irregular pores; 10 percent gravel; strongly acid; gradual smooth boundary.
A2-7 to 17 inches; dark brown (7.5YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure and moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and

slightly plastic; weakly smeary; many very fine irregular pores; many fine and medium roots; 10 percent gravel; strongly acid; clear wavy boundary.

Bw1-17 to 32 inches; brown (7.5YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and medium roots; many very fine tubular pores; 5 percent gravel; very strongly acid; gradual wavy boundary.

Bw2-32 to 46 inches; dark yellowish brown (10YR 4/4) silt loam, very pale brown (10YR 7/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; few fine roots; many very fine tubular pores; 5 percent gravel; very strongly acid; clear wavy boundary.

2BC-46 to 60 inches;. dark yellowish brown (10YR 4/4) very gravelly loam, very pale brown (10YR 7/4) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; 35 percent gravel and 10 percent cobbles; very strongly acid.

The mean annual soil temperature is 47 to 51 degrees F.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry. The content of clay is 15 to 20 percent, and the content of gravel is 0 to 15 percent.

The Bw horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 4 to 6 when moist or dry. The content of clay is 18 to 30 percent. The content of rock fragments range from 5 to 35 percent, of which 5 to 30 percent is gravel and 0 to 5 percent is cobbles.

The 2BC horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 5 to 7 when dry, and chroma of 4 or 5 when moist or dry. The content of clay is 15 to 25 percent. The content of rock fragments range from 35 to 60 percent, of which 30 to 50 percent is gravel and 0 to 10 percent is cobbles.

Humitropepts

Humitropepts are moderately deep to very deep, somewhat poorly drained to well drained soils on terraces and terrace escarpments. These soils formed in alluvium and in mixed colluvium and alluvium. Slopes are 0 to 60 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Reference pedon of Humitropepts, 25 to 60 percent slopes, in an area of woodland, about 50 feet northeast of road, in the SW1/4SE1/4SW1/4NE1 /4 of sec. 13, T. 7 N., R. 9 W., Willamette Meridian:

O-1 inch to 0; needles, twigs, leaves, and roots.

A-0 to 4 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine irregular pores; 5 percent hard gravel; extremely acid; clear wavy boundary.

AB-4 to 17 inches; very dark grayish brown (10YR 3/2) gravelly silt loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine irregular pores; 25 percent gravel and 5 percent cobbles; very strongly acid; clear wavy boundary.

Bw-17 to 24 inches; dark yellowish brown (10YR 4/4) extremely gravelly loam, yellowish brown (10YR 5/4) dry; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine irregular pores; 50 percent gravel and 15 percent cobbles; extremely acid; gradual wavy boundary.

C-24 to 36 inches; dark yellowish brown (10YR 3/4) extremely gravelly clay loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; moderate fine irregular pores; 45 percent gravel and 25 percent cobbles; extremely acid; abrupt wavy boundary.

Cr-36 inches; weathered siltstone.

The mean annual soil temperature is 49 to 63 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick. Depth to bedrock is 20 inches or more. Bedrock consists of sedimentary rock or volcanic rock.

The A horizon is loam or silt loam and is 0 to 50 percent rock fragments.

The B horizon is loam, silt loam, or silty clay loam and is 0 to 70 percent rock fragments.

The C horizon is sandy loam, loam, silt loam, clay loam, or silty clay loam and is 0 to 85 percent rock fragments.

Kilchis Series

The Kilchis series consists of shallow, well drained soils on mountainsides. These soils formed in mixed colluvium. Slopes are 60 to 90 percent. The mean annual precipitation is 60 to 90 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of a Kilchis very gravelly loam in an area of Kilchis-Rock outcrop complex, 60 to 90 percent slopes, in an area of woodland, above old spur off Spruce Run South Road, in the NW1/4SE1/4 of sec. 19, T. 4 N., R. 7 W., Willamette Meridian:

O-1 inch to 0; leaves, needles, twigs, and moss.

A-0 to 6 inches; dark brown (7.5YR 3/2) very gravelly loam, brown (7.5YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and medium irregular pores; 40 percent gravel; very strongly acid; gradual wavy boundary.

Bw-6 to 10 inches; dark brown (7.5YR 3/2) very gravelly loam, brown (7.5YR 5/2) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine and medium irregular pores; 40 percent gravel and 15 percent cobbles; very strongly acid; clear wavy boundary.

C-10 to 18 inches; dark brown (7.5YR 3/2) extremely cobbly loam, brown (7.5YR 5/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; common fine irregular pores; 30 percent gravel and 50 percent cobbles; strongly acid; abrupt wavy boundary.

R-18 inches; fractured basalt.

The mean annual soil temperature is 47 to 51 degrees F. Depth to bedrock is 12 to 20 inches. The umbric epipedon is 7 to 20 inches thick.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry. The content of coarse fragments is 35 to 55 percent. The content of clay is 12 to 27 percent.

The Bw horizon has hue of 7.5YR or 5YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 2 to 4 when moist or dry. The content of coarse fragments is 35 to 70 percent. The content of clay is 12 to 27 percent.

The C horizon has hue of 7.5YR or 5YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 3 or 4 when moist or dry. The content of coarse fragments is 75 to 85 percent. The content of clay is 12 to 27 percent.

Kirkendall Series

The Kirkendall series consists of very deep, well drained soils on flood plains. These soils formed in mixed alluvium weathered from sedimentary rock. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Kirkendall silt loam, 0 to 3 percent slopes, in an area of pasture, on the terrace between farmstead and the Nehalem River, in the NW1/4SE1/4NE1/4 of sec. 29, T. 5 N., R. 7 W., Willamette Meridian:

Ap-0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots and few medium roots; many medium irregular pores; very strongly acid; clear smooth boundary.

A-3 to 16 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine tubular pores; very strongly acid; gradual wavy boundary.

Bw1-16 to 27 inches; dark yellowish brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common, fine and very fine roots and few medium roots; common fine tubular pores; very strongly acid; clear wavy boundary.

Bw2-27 to 41 inches; dark yellowish brown (10YR 4/4) silt loam,. light yellowish brown (10YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine irregular pores and few fine tubular pores; very strongly acid; gradual wavy boundary.

BC-41 to 51 inches; yellowish brown (10YR 5/4) loam, light yellowish brown (10YR 6/4) dry; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; very strongly acid; gradual smooth boundary.

C-51 to 60 inches; yellowish brown (10YR 5/4) loam, light yellowish brown (10YR 6/4) dry; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The umbric epipedon is 10 to 20 inches thick. Faint mottles are below a depth-of 20 inches in some pedons. Lenses of coarser textured material are in some pedons.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 15 to 25 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma or 3 or 4 when moist or. dry. The content of clay is 20 to 35 percent.

The BC and C horizons have value of 4 or 5 when moist and 5 or 6 when dry, and they have chroma of 3 or 4 when moist or dry. The content of clay is 15 to 35 percent.

Klistan Series

The Klistan series consists of very deep, well drained soils on mountainsides. These soils formed in colluvium derived from basalt. Slopes are 30 to 90 percent. The mean annual precipitation is 60 to 90 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of a Klistan gravelly loam in an area of Klistan-Harslow complex, 60 to 90 percent slopes, in an area of woodland, about 100 feet southeast of spur road, in the NE1/4SE1/4SW1/4 of sec. 16, T. 4 N., R. 7 W., Willamette Meridian:

O-2 inches to 0; needles, leaves, twigs, and roots.
A1-0 to 8 inches; dark brown (7.5YR 3/2) gravelly loam, brown (7.5YR 5/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine and fine roots; many fine and very fine irregular pores; 30 percent basalt gravel and 15 percent concretions; very strongly acid; gradual wavy boundary.
A2-8 to 18 inches; dark brown (7.5YR 3/2) very gravelly loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine and fine roots; common fine and medium irregular pores; 40 percent basalt gravel and 10 percent concretions; very strongly acid; gradual wavy boundary.
Bw1-18 to 38 inches; dark yellowish brown (10YR 3/4) very gravelly loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common medium and fine roots; common medium irregular pores and common fine tubular . pores; 45 percent basalt gravel; very strongly acid; gradual wavy boundary.
Bw2-38 to 51 inches; dark yellowish brown (10YR 3/4) very gravelly loam, yellowish brown (10YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; moderate medium and fine roots; common medium irregular pores and common very fine tubular pores; 50 percent basalt gravel; very strongly acid; clear wavy boundary.
BC-51 to 60 inches; dark yellowish brown (10YR 4/4) very gravelly loam, light yellowish brown (10YR 6/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; 55 percent basalt gravel; very strongly acid.

The mean annual soil temperature is 47 to 51 degrees F. The umbric epipedon is 10 to 20 inches thick.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The apparent content of clay is 12 to 18 percent. The horizon is 20 to 50 percent gravel and 0 to 15 percent cobbles.

The Bw and BC horizons have hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 to 6 dry, and chroma of 3 or 4 when moist or dry. Chroma of 3 when moist is at a depth of less than 20 inches. The content of clay is 18 to 25 percent. The content of rock fragments is 40 to 70 percent, of which 40 to 55 percent is gravel and 0 to 15 percent is cobbles.

Klootchie Series

The Klootchie series consists of deep, well drained soils in mountainous areas. These soils formed in colluvium derived from basalt. Slopes are 3 to 60 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 51 degrees F.

Typical pedon of a Klootchie silt loam in an area of Klootchie-Necanicum complex, 30 to 60 percent slopes, in an area of woodland, north of Lewis and Clark Road, in the SW1/4SW1/4 of sec. 11, T. 6 N., R. 10 W., Willamette Meridian:

O-2 inches to 0; leaves, twigs, moss, and woody material.
A1-0 to 3 inches; dark reddish brown (5YR 3/2) silt loam, reddish brown (5YR 4/3) dry; moderate medium and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many medium, fine, and very fine roots; many fine and very fine irregular pores; 5 percent gravel; very strongly acid; gradual smooth boundary.
A2-3 to 12 inches; dark reddish brown (5YR 3/3) silt loam, reddish brown (5YR 5/3) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine, fine; and medium roots; many very fine and fine irregular pores; 10 percent gravel; very strongly acid; clear wavy boundary.
Bw-12 to 25 inches; reddish brown (5YR 4/4) silt loam, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine roots; common very fine and fine tubular pores; 10 percent gravel; very strongly acid; clear wavy boundary.
BC-25 to 43 inches; reddish brown (5YR 4/4) gravelly loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; few very fine roots; few very fine tubular pores; 30 percent gravel; very strongly acid; clear wavy boundary.
Cr-43 inches; partially weathered and semiconsolidated basalt with soil material in cracks and fractures.

The mean annual soil temperature is 47 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick. The paralithic contact is at a depth of 40 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 15 to 22 percent, and the content of basalt gravel is 5 to 15 percent.

The Bw horizon has hue of 5YR or 7.5YR, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 4 to 6 when moist or dry. The content of clay is 22 to 30 percent, and the content of basalt gravel is 5 to 15 percent.

The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 to 6 when moist or dry. The content of clay is 20 to 30 percent, and the content of basalt gravel is 15 to 35 percent.

Knappa Series

The Knappa series consists of very deep, well drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 15 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Knappa silt loam, 0 to 7 percent slopes, in an area of woodland, east of Astoria on Oregon Highway 30 to road west of John Day River bridge and beyond end of road and house south of the "Y" in the road; in the NW1/4NE1/4NW1/4 of sec. 30, T. 8 N., R. 8 W., Willamette Meridian:

O-1 inch to 0; duff layer of needles and twigs.

A1-0 to 9 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular pores; extremely acid; clear wavy boundary.

A2--9 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine irregular pores; extremely acid; gradual smooth boundary.

BA-14 to 23 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and fine roots; many very fine tubular pores; extremely acid; gradual smooth boundary.

Bw1-23 to 36 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; many very fine tubular pores; very strongly acid; gradual smooth boundary.

Bw2-36 to 45 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores;, very strongly acid; gradual smooth boundary.

BC-45 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; hard, firm, sticky and plastic; many very fine tubular pores; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 20 to 34 inches thick.

The A and BA horizons have hue of 10YR or 7.5YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 15 to 25 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. The content of clay is 22 to 35 percent.

The BC horizon has hue of 10YR or 7.5YR, value of 4 or .5 when moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. The content of clay is 22 to 35 percent.

Knappa Variant

The Knappa Variant consists of very deep, well drained soils on terraces. These soils formed in mixed alluvium. Slopes are 3 to 15 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Knappa Variant loam, 3 to 15 percent slopes, in an area of woodland, about 200 feet south of 4-H arena, in the SW1/4NW1/4 of sec. 30, T. 8 N., R. 7 W., Willamette Meridian:

O1-3 to 2 inches; needles, roots, twigs, and leaves:

O2-2 inches to 0; decomposed needles, twigs, and leaves.

A1-0 to 3 inches; very dark brown (7.5YR 2/2) loam, dark brown (7.5YR 4/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many medium irregular pores; 5 percent gravel; strongly acid; clear smooth boundary.

A2-3 to 13 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine

roots; common fine and medium irregular pores; 5 percent gravel; strongly acid; clear wavy boundary.
AB-13 to 21 inches; dark reddish brown (5YR 3/3) silt loam, reddish brown (5YR 5/3) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 5 percent gravel; very strongly acid; abrupt smooth boundary.
Bw-21 to 34 inches; dark yellowish brown (10YR 3/4) gravelly clay loam, yellowish brown (10YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; 10 percent hard basalt gravel and 30 percent soft gravel; extremely acid; gradual wavy boundary.
BC-34 to 45 inches; dark yellowish brown (10YR 4/4) gravelly loam, yellowish brown (10YR 5/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; common very fine tubular pores; 15 percent hard basalt gravel, 35 percent soft gravel, and 5 percent hard cobbles; very strongly acid; gradual wavy boundary.
C2-45 to 60 inches; dark yellowish brown (10YR 4/4) extremely cobbly loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; no roots; few fine tubular pores; 30 percent hard cobbles, 35 percent hard gravel, and 10 percent soft gravel; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 20 to 30 inches thick.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 2 or 3 when moist or dry. It is 0 to. 10 percent hard gravel and 18 to 32 percent clay.

The Bw and SC horizons have hue of 7.5YR or 10YR, value of 3 or 4 moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry. Chroma of 3 when moist is at a depth of less than 30 inches. The horizon is 5 to 30 percent hard gravel and 0 to 15 percent hard cobbles. The content of clay is 27 to 35 percent.

The C horizon have hue of 10YR or 7.5YR, value of 4 or 5 moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. It is 65 to 85 percent rock fragments, of which 15 to 35 percent is hard gravel and 30 to 70 percent is hard cobbles. The content of clay is 12 to 20 percent.

Laderly Series

The Laderly series consists of moderately deep, well drained soils on ridges and side slopes in mountainous areas. These soils formed in mixed colluvium. Slopes are 3 to 90 percent. The mean annual precipitation is 80 to 100 inches. The mean annual air temperature is 41 to 45 degrees F.

Typical pedon of a Laderly very gravelly loam in an area of Caterl-Laderly complex, 30 to 60 percent slopes, about 0:6 mile south on Military Creek Road from junction with Green Mountain Road, about 100 feet northwest of road in the SE1/4SE1/4NW1/4 of sec. 34, T. 5. N., R. 6 W., Willamette Meridian:

O-1 inch to 0; needles, leaves, roots, and twigs.
A1-0 to 3 inches; very dark brown (7.5YR 2/2) very gravelly loam, dark brown (10YR 3/3) dry; moderate very fine and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; many very fine irregular pores; 40 percent gravel; very strongly acid; clear wavy boundary.
A2-3 to 6 inches; dark brown (7.5YR 3/3) very gravelly loam, brown (10YR 4/3) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common very fine and few coarse roots; many very fine irregular pores; 35 percent gravel; very strongly acid; clear wavy boundary.
AB-6 to 16 inches; dark brown (7.5YR 3/3) very gravelly loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and medium roots and few coarse roots; many very fine irregular pores; 35 percent gravel; very strongly acid; gradual wavy boundary.
Bw1-16 to 21 inches; dark brown (7.5YR 3/4) very gravelly loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and medium roots; many very fine irregular pores; 40 percent gravel; very strongly acid; clear wavy boundary.
Bw2-21 to 37 inches; dark brown (7.5YR 3/4) extremely cobbly loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; few medium and coarse roots; many very fine irregular pores; 25 percent gravel, 25 percent cobbles, and 10 percent stones; very strongly acid; gradual wavy boundary.
R-37 inches; fractured basalt.

The mean annual soil temperature is 42 to 46 degrees F. Depth to bedrock is 20 to 40 inches. The umbric epipedon is 10 to 20 inches thick. The textural control section is 35 to 85 percent rock fragments.

The A horizon has hue of 10YR to 5YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 2 or 3 when moist and 3 when dry. The content of clay is 12 to

18 percent. The horizon is 30 to 50 percent gravel and 0 to 10 percent cobbles.

The Bw horizon has hue of 10YR to 5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 4 or 5 when moist and 5 or 6 when dry. The content of clay is 15 to 18 percent. The content of rock fragments is 35 to 85 percent, of which 20 to 60 percent is gravel, 0 to 50 percent is cobbles, and 0 to 15 percent is stones.

Locoda Series

The Locoda series consists of very deep, very poorly drained soils on flood plains influenced by tides. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 49 to 52 degrees F.

Typical pedon of Locoda silt loam, 0 to 3 percent slopes, in an area of pasture, near the Clatsop County line, in the SE1/4NE1/4SE1/4 of sec. 36, T. 8 N., R. 6 W., Willamette Meridian:

Ap1-0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common fine distinct brown (7.5YR 4/4) mottles; moderate very fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine irregular pores; very strongly acid; clear smooth boundary.

Ap2-5 to 10 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (10YR 6/2) dry; many medium prominent strong brown (7.5YR 4/6) mottles; common fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine tubular pores; very strongly acid; clear smooth boundary.

C1-10 to 26 inches; gray (5Y 5/1) silty clay loam, light gray (5Y 6/1) dry; many medium prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; very strongly acid; clear wavy boundary.

C2-26 to 60 inches; gray (5Y 5/1) silt loam, light gray (5Y 6/1) dry; massive; hard, firm, sticky and slightly plastic; common very fine roots; common very fine tubular pores; extremely acid.

The mean annual soil temperature is 50 to 53 degrees F.

The A horizon has hue of 10YR or 2.5Y, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 1 or 2 when moist or dry. The content of clay is 15 to 22 percent.

The C horizon has hue of 2.5Y to 5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 0 or 1 when moist or dry. The content of clay is 18 to 35 percent.

Mayger Series

The Mayger series consists of very deep, somewhat poorly drained soils on mountains. These soils formed in colluvium. Slopes are 3 to 30 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 45 to 49 degrees F.

Typical pedon of Mayger silt loam, 3 to 30 percent slopes (fig. 15), in a clearcut area of woodland, about 100 feet north of Wage Road, in the NE1/4NW1/4 of sec. 18, T. 5 N., R. 6 W., Willamette Meridian:

A1-0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; hard, friable, slightly sticky and plastic; many fine and medium roots; common medium irregular pores; very strongly acid; clear wavy boundary.

A2-6 to 12 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure and moderate fine subangular blocky structure; hard, friable to firm, sticky and plastic; many fine and medium roots; common medium irregular pores; very strongly acid; clear wavy boundary.

Bt1-12 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; strong fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common medium and few fine irregular pores; common thin clay films on peds; very strongly acid; abrupt wavy boundary.

Bt2-18 to 29 inches; grayish brown (10YR 5/2) silty clay loam, light brownish gray (10YR 6/2) dry; common medium prominent yellowish brown (10YR 5/6) mottles; strong medium prismatic structure; very hard, firm, sticky and plastic; common fine and medium roots; common fine and medium tubular pores; common pressure faces; many moderately thick clay films on peds; extremely acid; clear wavy boundary.

2Bt1-29 to 38 inches; grayish brown (10YR 5/2) silty clay, pale brown (10YR 6/3) dry; many medium prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common fine tubular pores; many thin clay films on peds; extremely acid; clear wavy boundary.

2Bt2-38 to 60 inches; grayish brown (10YR 5/2) silty, clay, light gray (10YR 7/2) dry; many medium prominent strong brown (7.5YR 5/8) mottles; moderate fine and medium angular blocky structure; hard, firm, sticky and plastic; very few fine roots; common very fine tubular pores; few thin clay films on peds; very strongly acid.

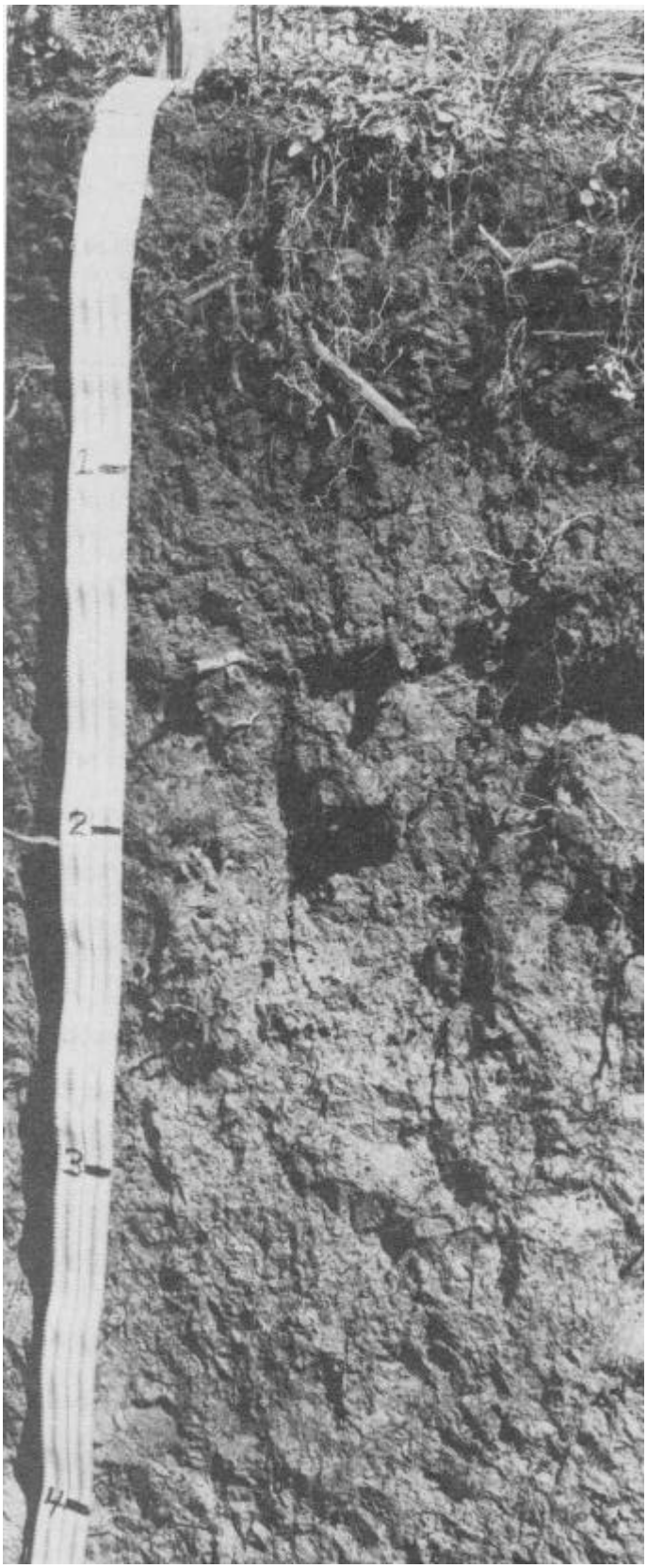

Figure 15.-Profile of Mayger silt loam, 3 to 30 percent slopes.

The mean annual soil temperature is 49 to 51 degrees F. Depth to bedrock is more than 60 inches.

The A horizon has value of 2 to 4 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or dry. The content of clay is 15 to 25 percent.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 35 to 40 percent.

The 2Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 45 to 70 percent.

McMille Series

The McMille series consists of very deep, well drained soils in mountainous areas. These soils formed in colluvium derived from marine sediment. Slopes are 3 to 60 percent. The mean annual precipitation is 80 to 100 inches. The mean annual air temperature is 41 to 45 degrees F.

Typical pedon of McMille silt loam, 3 to 30 percent slopes, in an area of woodland, about 300 feet from Road 210, about 5 miles from junction with Rock Creek Road, in the SW1/4NE1/4NE1/4 of sec. 4, T. 4 N., R. 6 W., Willamette Meridian:

O-2 inches to 0; needles, twigs, leaves, and roots.

A1-0 to 6 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine and very fine roots and common coarse and medium roots; many fine and medium irregular pores; very strongly acid; clear wavy boundary.

A2-6 to 14 inches; dark brown (7.5YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and medium roots; many fine and very fine tubular pores; very strongly acid; clear wavy boundary.

Bw-14 to 28 inches; brown (7.5YR 5/4) silt loam, very pale brown (10YR 7/4) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; many fine tubular pores; extremely acid; gradual wavy boundary.

BC-28 to 42 inches; brown (7.5YR 5/4) silt loam, very pale brown (10YR 7/.4) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; many fine tubular pores; extremely acid; gradual wavy boundary.

2C-42 to 56 inches; brown (10YR 4/3) very fine sandy loam, very pale brown (10YR 7/3) dry; strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) streaks;

massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine vesicular pores; extremely acid.

3Cr-56 inches; weathered sandstone.

The mean annual soil temperature is 42 to 46 degrees F. The umbric epipedon is 10 to 20 inches. Depth to the paralithic contact is 40 to 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 18 to 24 percent, and the content of fine concretions is 0 to 30 percent.

The Bw and BC horizons have hue of 7.5YR or 10YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 18 to 24 percent.

The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6 when moist and 6 or 7 when dry, and chroma of 3 to 8 when moist or dry. It is silt loam, loam, or very fine sandy loam. The content of clay is 8 to 20 percent.

McNulty Series

The McNulty series consists of deep, well drained soils on flood plains. These soils formed in recent mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of McNulty silt loam, 0 to 3 percent slopes; about 50 feet from the bank of the Nehalem River, next to the big bend on the River Bend Ranch; 2,500 feet south and 2,000 feet west of the northeast corner of sec. 29, T. 5 N., R. 7 W., Willamette Meridian:

Ap-0 to 9 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium and fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many medium irregular pores; very strongly acid; clear wavy boundary.

Bw1-9 to 15 inches; dark yellowish brown (10YR 4/4) loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and many very fine roots; many fine irregular pores; very strongly acid; clear wavy boundary.

Bw2-15 to 40 inches; dark brown (7.5YR 4/4) fine sandy loam, light yellowish brown (10YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; many very fine tubular pores; very strongly acid; gradual wavy boundary.

C-40 to 60 inches; dark brown (7.5YR 4/4) sandy loam, light yellowish brown (10YR 6/4) dry; massive; soft, very friable, nonsticky and nonplastic; few fine roots; many very fine tubular pores; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The textural control section is 12 to 18 percent clay and more than 15 percent material that is coarser than very fine sand. The umbric epipedon is less than 10 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 12 to 18 percent.

The B horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 12 to 18 percent.

The C horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It is stratified sandy loam, loam, or silt loam. Loamy sand is below a depth of 40 inches in some pedons. The content of clay is 8 to 18 percent.

Millicoma Series

The Millicoma series consists of moderately deep, well drained soils on mountains. These soils formed in colluvium derived from marine sediment. Slopes are 30 to 60 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 50 degrees F.

Typical pedon of Millicoma gravelly loam, 30 to 60 percent slopes, in an area of woodland where the timber has been harvested, about 75 feet downslope from a logging spur landing, in the SW1/4NW1/4SE1/4 of sec. 19, T. 5 N., R. 8 W., Willamette Meridian:

O1-4 to 2 inches; needles, twigs, moss, and woody material.

O2-2 inches to 0; partially decomposed needles, leaves, and woody material.

A1-0 to 2 inches; very dark brown (7.5YR 2/2) gravelly loam, dark brown (7.5YR 3/2) dry; moderate fine and very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 20 percent hard gravel and 5 percent soft gravel; extremely acid; clear smooth boundary.

A2-2 to 9 inches; dark brown (7.5YR 3/2) gravelly loam, dark brown (7.5YR 3/4) dry; moderate very fine subangular blocky structure parting to-moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 30 percent hard gravel and 10 percent soft gravel; very strongly acid; clear wavy boundary.

BA-9 to 15 inches; dark brown (7.5YR 3/2) gravelly loam, brown (7.5YR 4/4) dry; moderate fine and

very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; about 30 percent hard gravel and 5 percent soft gravel; very strongly acid; gradual wavy boundary.

Bw-15 to 32 inches; brown (7.5YR 4/4) very gravelly loam, yellowish brown (10YR 5/4) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine roots; many very fine tubular pores; about 50 percent hard gravel and 5 percent hard cobbles; very strongly acid; gradual wavy boundary.

C-32 to 38 inches; strong brown (7.5YR 4/6) extremely gravelly loam, light yellowish brown (10YR 6/4) dry; massive; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine, tubular pores; about 60 percent hard gravel and 10 percent hard cobbles; very strongly acid; gradual wavy boundary.

Cr-38 inches; weathered siltstone.

The mean annual soil temperature is 47 to 51 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 17 inches. Depth to bedrock is 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 2 to 4 when moist or dry. The content of clay is 10 to 25 percent. The horizon is 15 to 30 percent hard gravel and 5 to 15 percent soft gravel.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of.4 when moist or dry. The content of clay is 10 to 25 percent. The horizon is 35 to 60 percent hard gravel and 5 to 10 percent hard cobbles.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma or 4 or 6 when moist or dry. The content of clay is 10 to 25 percent. The horizon is 55 to 70 percent hard gravel and 5 to 10 percent hard cobbles.

Mues Series

The Mues series consists of very deep, moderately well drained soils on stream terraces. These soils formed in silty alluvium over consolidated gravelly alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Mues silt loam, 0 to 3 percent slopes, in-an area of pasture, about 125 feet northeast of farmhouse near the Lewis and Clark River, in the NW1/4NW1/4NE1/4 of sec. 18, T. 7 N., R. 9 W., Willamette Meridian:

Ap-0 to 6 inches; very dark brown (7.5YR 2/2) silt loam, dark brown (10YR 4/3) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; many very fine roots; many very fine tubular and irregular pores; very strongly acid; clear smooth boundary.

A-6 to 11 inches; very dark brown (7.5YR 2/2) silt loam, dark brown (10YR 4/3) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; many very fine tubular pores; very strongly acid; gradual smooth boundary.

AB-11 to 25 inches; dark brown (7.5YR 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; weakly smeary; many very fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.

Bw1-25 to 31 inches; brown (7.5YR 4/4) silt loam, brown (10YR 5/4) dry; few fine faint strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary;. many very fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.

Bw2--31 to 36 inches; brown (7.5YR 4/4) silt loam, brown (10YR 5/4) dry; many medium distinct yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common very fine roots; many very fine tubular pores; very strongly acid; clear wavy boundary.

2C-36 to 60 inches; pale brown and light yellowish brown (10YR 6/4 and 6/3) very gravelly loam, light gray and very pale brown (10YR 7/2 and 7/3) dry; many medium distinct yellowish brown (10YR 5/8) and brown (7.5YR 5/4) mottles; strongly consolidated; extremely hard, extremely firm; 45 percent gravel and 10 percent cobbles; very strongly acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 20 to 30 inches thick. Depth to the strongly consolidated very gravelly substratum is 25 to 40 inches.

The A or Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 15 to 25 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 15 to 25 percent.

The 2C horizon has value of 6 or 7 when moist or dry, and it has chroma of 2 to 4 when moist or dry. It is 40 to 65 percent gravel and 5 to 15 percent cobbles.

Murtip Series

The Murtip series consists of deep, well drained soils in mountainous areas. These soils formed in mixed colluvium. Slopes are 3 to 60 percent. The mean annual precipitation is 80 to 100 inches. The mean annual air temperature is 41 to 45 degrees F.

Typical pedon of Murtip loam, 3 to 30 percent slopes, in an area of woodland, 0.3 mile east on Spur 205 from the junction with Military Creek Road, in the SE1/4SW1/4 of sec. 7, T. 4 N., R. 6 W., Willamette Meridian:

O-2 inches to 0; needles, leaves, twigs, and roots.
A1-0 to 2 inches; very dark brown (7.5YR 2/2) loam, dark brown (7.5YR 4/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; many very fine roots; many very fine irregular pores; many very fine soft nodules; strongly acid; clear smooth boundary.
A2-2 to 11 inches; dark brown (7.5YR 3/2) loam, reddish brown (5YR 4/3) dry; moderate fine and very fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; moderately smeary; many very fine and fine roots; many fine irregular pores; many very fine nodules; very strongly acid; clear wavy boundary.
Bw1-11 to 29 inches; dark brown (7.5YR 4/4) loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately-smeary; common very fine roots; many very fine tubular pores; very strongly acid; gradual smooth boundary.
Bw2-29 to 38 inches; brown (7.5YR 4/4) loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; common very fine roots; many very fine tubular pores; 10 percent gravel; very strongly acid; clear smooth boundary.
Bw3-38 to 48 inches; brown (7.5YR 4/4) gravelly loam, light yellowish brown (10YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; common fine roots; common very fine tubular pores; 30 percent gravel; very strongly acid; clear wavy boundary.
BC-48 to 54 inches; brown (7.5YR 4/4) very gravelly loam, light yellowish brown (10YR 6/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; few fine roots; few very fine tubular pores; 45 percent gravel; very strongly acid; clear wavy boundary.
Cr-54 inches; fractured and partially weathered basalt.

The mean annual soil temperature is 42 to 46 degrees F. The umbric epipedon is 10 to 20 inches thick. The profile is strongly acid or extremely acid. Depth to bedrock is 40 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 2 or 3 when moist or dry. It is 0 to 10 percent gravel-sized basalt fragments. Apparent clay content is 12 to 20 percent.

The Bw horizon has hue of 5YR to 10YR, value of 4 or 5 when moist and 4 to 6 when dry, and chroma of 4 to 6 when moist or dry. It is 0 to 30 percent gravel-sized basalt fragments. Apparent clay content is 18 to 24 percent.

The BC horizon has hue of 5YR to 10YR, value of 4 or 5 when moist and 4 to 6 when dry, and chroma of 4 to 6 when moist or dry. It is 35 to 55 percent gravel. Apparent clay content is 18 to 24 percent.

Natal Series

The Natal series consists of deep, poorly drained soils on stream terraces. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Natal silty clay loam, 0 to 3 percent slopes, in an area of native vegetation; near the base of a terrace, east of driveway south of Oregon Highway 202; in the SW1/4NE1/4NW1/4 of sec. 25, T. 6 N., R. 6 W., Willamette Meridian:

Ap-0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, firm, sticky and plastic; many very fine, fine, and medium roots; common fine and medium irregular pores; very strongly acid; clear smooth boundary.
AB-6 to 16 inches; dark gray (10YR 4/1) silty clay loam; gray (10YR 5/1) dry; many fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; common fine and medium irregular pores and few fine tubular pores; few thin clay films in pores; very strongly acid; clear wavy boundary.
Bt1-16 to 34 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; many fine and very fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; common fine and medium

roots; common fine irregular and tubular pores; few thin clay films in pores; very strongly acid; clear wavy boundary.

Bt2-34 to 47 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 3/6) mottles; moderate coarse prismatic structure; very hard, firm, very sticky and very plastic; few fine roots; common very fine tubular pores; few thin clay films in pores and on peds; very strongly acid; clear wavy boundary.

C-47 to 60 inches; dark grayish brown (2.5Y-4/2) silty clay, light gray (2.5Y 7/2) dry; common fine prominent yellowish brown (10YR 5/8) mottles; massive; hard, firm, very sticky and very plastic; no roots; common very fine tubular pores; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The A horizon has value of 2 or 3 when moist and 3 or 4 when dry, and It has chroma of 1 or 2 when moist or dry. The content of clay is 27 to 35 percent.

The Bt horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 1 or 2 when moist or dry. The content of clay is 40 to 50 percent.

The C horizon has hue of 2.5Y or 10YR, value of 3 or 4 when moist and 5 to 7 when dry, and chroma of 1 or 2 when moist or dry. The content of clay is 40 to 50 percent.

Necanicum Series

The Necanicum series consists of deep, well drained soils in mountainous areas. These soils formed in colluvium weathered from basalt. Slopes are 3 to 90 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 51 degrees F.

Typical pedon of a Necanicum gravelly loam in an area of Necanicum-Ascar complex, 30 to 60 percent slopes; in a forested area; in the NE1/4NW1/4 of sec. 10, T. 6 N., R. 9 W., Willamette Meridian:

O-2 inches to 0; roots, needles, twigs, and moss.

A1-0 to 7 inches; dark reddish brown (5YR 3/2) gravelly loam, dark reddish gray (5YR 4/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; many very fine and fine roots; many fine and medium irregular pores; 25 percent gravel; very strongly acid; gradual smooth boundary.

A2-7 to 12 inches; dark reddish brown (5YR 3/3) very gravelly loam, reddish brown (5YR 5/3) dry; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine and fine roots; many fine and medium irregular pores; 35 percent gravel; extremely acid; clear wavy boundary.

Bw1-12 to 20 inches; dark brown (7.5YR 4/4) very gravelly loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many very fine roots; common fine tubular pores and common medium irregular pores; 30 percent gravel and 10 percent cobbles; very strongly acid; gradual wavy boundary.

Bw2-20 to 35 inches; dark yellowish brown (10YR 4/4) very gravelly loam, light brown (7.5YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine roots; common fine tubular pores; 45 percent gravel and 15 percent cobbles; very strongly acid; gradual wavy boundary.

BC-35 to 48 inches; yellowish brown (10YR 5/4) extremely cobbly loam, light brown (7.5YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; few fine roots; common medium irregular pores; 50 percent cobbles, 25 percent gravel, and 5 percent stones; extremely acid; gradual wavy boundary.

R-48 inches; fractured basalt.

The mean annual soil temperature is 47 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to bedrock is 40 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. It is 20 to 35 percent gravel and 0 to 10 percent cobbles. The content of clay is 10 to 18 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 4 or 6 when moist or dry. It is 30 to 50 percent gravel and 10 to 20 percent cobbles. The content of clay is 12 to 18 percent.

The BC horizon has hue of 7.5YR or 10YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. It is 65 to 80 percent rock fragments, of which 20 to 30 percent is gravel, 40 to 50 percent is cobbles, and 5 to 10 percent is stones. The content of clay is 8 to 20 percent.

Nehalem Series

The Nehalem series consists of very deep; well drained soils on flood plains. These soils formed in alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Nehalem silt loam, 0 to 3 percent slopes, in an area of pasture; about 60 feet east of U.S. Highway 101, 0.5 mile south of Seaside; in the

SE1/4SE1/4 of sec. 28, T. 6 N., R. 10 W., Willamette Meridian:

Ap-0 to 6 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; very strongly acid; abrupt smooth boundary.

A-6 to 14 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular and tubular pores; very strongly acid; clear wavy boundary.

Bw1-14 to 22 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; very strongly acid; gradual wavy boundary.

Bw2-22 to 34 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; strongly acid; gradual smooth boundary.

BC-34 to 48 inches; dark yellowish brown (10YR 4/6) silt loam,, brownish yellow (10YR 6/6) dry; weak medium subangular blocky structure; hard, friable, sticky and slightly plastic; few fine roots; many very fine tubular pores; strongly acid; abrupt wavy boundary.

C-48 to 60 inches; brown (10YR 5/3) silty clay loam, light gray (10YR 7/2) dry; massive; hard, firm, sticky and plastic; few fine roots; many very fine tubular pores; very strongly acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick. Thin lenses of coarse textured material are in some pedons.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 15 to 25 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. The content of clay is 20 to 35 percent.

The C horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 to 8 when moist or dry. The content of clay is. 20 to 35 percent. In some pedons the C horizon is loamy below a depth of 40 inches.

Nestucca Series

The Nestucca series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Nestucca silt loam, 0 to 3 percent slopes, in an area of pasture; west of the Necanicum River and east of powerline; in the SW1/4NW1/4 of sec. 33, T. 6 N., R. 10 W., Willamette Meridian:

Ap-0 to 6 inches; dark brown (10YR 3/3) silt loam, brown (10YR 4/3) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; strongly acid; clear wavy boundary.

A-6 to 16 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and medium irregular pores; strongly acid; clear wavy boundary.

B1g-16 to 25 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine distinct yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and medium tubular pores; strongly acid; gradual wavy boundary.

B2g-25 to 32 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; many medium distinct brown (7.5YR 5/4) mottles; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine and very fine tubular pores; slightly acid; clear wavy boundary.

BCg-32 to 46 inches; grayish brown (10YR 5/2) silty clay loam, light brownish gray (10YR 6/2) dry; many medium prominent strong brown (7.5YR 5/8, 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; many fine and very fine tubular pores; strongly acid; clear wavy boundary.

Cg-46 to 60 inches; grayish brown (10YR 5/2) silty clay loam, light brownish gray (10YR 6/2) dry; many prominent strong brown (7.5YR 5/8) mottles; massive; hard, firm, sticky and plastic; few fine roots; many very fine tubular pores; strongly acid.

The mean annual soil temperature is about 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or

dry. Chroma of 3 when moist is at a depth of 6 inches or less. The content of clay is 18 to 27 percent.

The Bg horizon has hue of 10YR to 5Y, value of 4 or 5 when moist and 5 to 7 when dry, and chroma of 1 or 2 when moist or dry. Chroma of 1 when moist is below a depth of 30 inches. The content of clay is 25 to 35 percent.

The Cg horizon has hue of 10YR to 5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 1 or 2 when moist or dry. The content of clay is 25 to 35 percent. Thin lenses of coarser textured material are in some pedons. In some pedons the C horizon is loamy below a depth of 40 inches.

Newanna Series

The Newanna series consists of moderately deep, well drained soils in mountainous areas. These soils formed in mixed colluvium. Slopes are 3 to 90 percent. The mean annual precipitation is 80 to 100 inches. The mean annual air temperature is 40 to 44 degrees F.

Typical pedon of Newanna gravelly loam, 3 to 30 percent slopes, north of lookout tower on Mt. Nicolai, about 1,320 feet north and 1,240 feet west of the southeast corner of sec. 17, T. 7 N., R. 6 W., Willamette Meridian:

A-0 to 12 inches; dark reddish brown (5YR 3/2) gravelly loam, dark reddish gray (5YR 4/2) dry; -moderate fine and very fine granular structure; soft, friable, slightly sticky and slightly plastic; weakly smeary; many very fine, fine, and medium roots; many very fine irregular pores; 15 percent gravel; very strongly acid; clear wavy boundary.

Bw-12 to 21 inches; dark reddish brown (5YR 3/4) very cobbly loam, strong brown (7.5YR 5/6) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; common fine and very fine roots; many very fine tubular pores; 15 percent gravel, 30 percent cobbles, and 10 percent stones; very strongly acid; clear wavy boundary.

BC-21 to 26 inches; strong brown (7.5YR 4/6) very stony loam, reddish yellow (7.5YR 6/6) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; few very fine roots; common fine tubular pores; 55 percent stones; very strongly acid; abrupt smooth boundary.

R-26 inches; fractured basalt.

The mean annual soil temperature is 41 to 45 degrees F. The umbric epipedon is 10 to 20 inches thick. The textural control section averages 10 to 20* percent clay and 35 to 60 percent rock fragments. Bedrock is at a depth of 20 to 40 inches.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. It is 15 to 25 percent gravel and 0 to 10 percent cobbles. The content of clay is 10 to 20 percent.

The BC horizon has hue of 7.5YR or 10YR, value of 4 when moist and 5 or 6 when dry, and chroma of 4 to 6 when moist or dry. It is very stony loam or very cobbly loam. It is 0 to 15 gravel and 40 to 60 percent cobbles and stones. The content of clay is 10 to 15 percent.

Northrup Series

The Northrup series consists of very deep, somewhat poorly drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 15 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Northrup silt loam, 0 to 7 percent slopes, in an area of pasture; about 0.5 mile west of Fishhawk Falls Highway .on a road that has its junction with the highway north of the bridge across the Nehalem . River, 200 feet north of road; in the SW1/4SE1/4SW1/4 of sec. 21, T. 5 N., R. 7 W., Willamette Meridian:

Ap-0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common medium irregular pores; very strongly acid; clear smooth, boundary.

A-6 to 18 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 fine and very fine roots; common medium and fine irregular pores; very strongly acid; clear wavy boundary.

Bt1-18 to 24 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; common very fine distinct (7.5YR 5/8) mottles; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots; common very fine tubular pores; common thin clay films on peds; extremely acid; clear wavy boundary.

Bt2-24 to 44 inches; pale brown (10YR 6/3) silt loam, very pale brown (10YR 7/3) dry; many very fine prominent (5YR 5/8) mottles; moderate fine subangular blocky structure; hard, friable to firm, sticky and slightly plastic; few fine roots; many very fine tubular pores and common fine irregular pores; few thin clay films on peds and in pores; extremely acid; gradual smooth boundary.

C-44 to 60 inches; light yellowish brown (10YR 6/4) silt loam, very pale brown (10YR 7/4) dry; many medium distinct strong brown (7.5YR 5/8) and light gray (10YR 7/2) mottles; massive;. slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; 30 percent weathered gravel; extremely acid.

The mean annual soil temperature is 49 to 52 degrees F. The umbric epipedon is 10 to 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 20 to 27 percent.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 when moist and 6 or 7 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 25 to 35 percent. Mottles are common to many and distinct to prominent.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 when moist and 6 or 7 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 20 to 25 percent. The content of weathered gravel is 0 to 30 percent.

Rinearson Series

The Rinearson series consists of deep, well drained soils in mountainous areas. These soils formed in colluvium derived from siltstone. Slopes are 3 to 90 percent. The mean annual precipitation is 60 to 90 inches. The mean annual air temperature is 45 to 49 degrees F.

Typical pedon of Rinearson silt loam,. 3 to 30 percent slopes, in a wooded area, on a spur logging road east of Northrup Creek Road; in the SW1/4SW1/4 of sec. 15, T. 6 N. R. 6 W., Willamette Meridian:

O-1 inch to 0; loose litter of twigs, needles, and leaves.
A1-0 to 3 inches;, very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine granular structure; slightly hard; friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular pores; strongly acid; clear wavy boundary.
A2-3 to 15 inches; very dark brown (10R 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and fine subangular blocky structure parting to moderate medium granular; slightly hard, friable,. sticky and slightly plastic; many very fine roots; many fine and very fine irregular pores; very strongly acid; clear wavy boundary.
Bw1-15 to 28 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common medium roots; many very fine tubular pores; extremely acid; gradual smooth boundary.
Bw2-28 to 34 inches; dark brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic, few, very fine roots; common very fine tubular pores; extremely acid; gradual smooth boundary.
C-34 to 48 inches; yellowish brown (10YR 5/6) loam, brownish yellow (10YR 6/6) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; about 30 percent medium and fine soft siltstone fragments; few very fine roots; common very fine tubular pores; extremely acid; gradual wavy boundary.
Cr-48 inches; weathered siltstone.

The mean annual soil temperature is 49 to 52 degrees F. Depth to the paralithic contact is 40 to 60 inches. The umbric epipedon is 10 to 20 inches thick.

The A horizon has hue of 7:5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 20 to 27 percent.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 or 5 when dry, ,and chroma of 4 or 6 when moist or dry. The content of clay is 25 to 35 percent. The horizon is 5 to 25 percent weathered siltstone gravel and 0 to 10 percent weathered cobbles.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 4 or 5 when moist or dry. The content of clay is 22 to 35 percent. The horizon is 15 to 35 percent weathered siltstone gravel and 0 to 25 percent weathered cobbles.

Scaponia Series

The Scaponia series consists of deep, well drained soils in mountainous areas. These soils formed in colluvium derived from siltstone. Slopes are 3 to 90 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 45 to 51 degrees F.

Typical pedon of a Scaponia silt loam in an area of Scaponia-Braun silt loams, 30 to 60 percent slopes, in a wooded area, about 200 feet northwest of road in the NE1/4NW1/4SW1/4 of sec. 13, T. 4 N., R. 6 W., Willamette Meridian:

O-2 inches to 0; needles, twigs, roots, and leaves.
A-0 to 7 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine irregular pores; many very fine concretions; 10 percent soft gravel;, very strongly acid; clear wavy boundary.
Bw1-7 to 13 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 20 percent soft gravel; very strongly acid; gradual smooth boundary.
Bw2-13 to 24 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and

slightly plastic; common very fine and fine roots; many very fine tubular pores; 30 percent soft gravel; very strongly acid; clear wavy boundary.

BC-24 to 43 inches; yellowish brown (10YR 5/6) silt loam, brownish yellow (10YR 6/6) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 50 percent soft gravel and 10 percent soft cobbles; very strongly acid; clear wavy boundary.

Cr-43 inches; highly fractured siltstone.

The mean annual soil temperature is 47 to 52 degrees F. Depth to the paralithic contact is 40 to 60 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. The content of clay is 12 to 18 percent. The content of soft siltstone gravel is 5 to 15 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 3 or 4 moist or dry. The content of soft siltstone gravel and cobbles is 10 to 45 percent.

The BC horizon has value of 4 or 5 when moist and 5 or 6 when dry, and it has chroma of 4 or 5 when moist , or dry. The content of clay is 18 to 27 percent. The content of soft siltstone gravel and cobbles is 40 to 70 percent.

Skipanon Series

The Skipanon series consists of deep, well drained soils in mountainous areas. These soils formed in mixed colluvium. Slopes are 3 to 60 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 51 degrees F.

Typical pedon of Skipanon gravelly silt loam, 3 to 30 percent slopes, on a roadcut along spur landing road in the NW1/4NW1/4NE1/4 of sec. 34, T. 5 N., R. 9 W., Willamette Meridian:

O-2 inches to 0; needles, twigs, moss, and woody material.

A-0 to 14 inches; dark brown (7.5YR 3/2) gravelly silt loam, dark brown (7.5YR 3/3) dry; moderate fine subangular blocky structure and moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly smeary; many very fine roots; many very fine irregular pores; 15 percent gravel and 5 percent cobbles; very strongly acid; clear wavy boundary.

AB-14 to 19 inches; dark brown (7.5YR 3/3) gravelly silt loam, brown (7.5YR 4/4) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 15 percent gravel; very strongly acid; clear wavy boundary.

Bw-19 to 36 inches; brown (7.5YR 4/4) cobbly silt loam, brownish yellow (10YR 6/6) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 15 percent gravel, 15 percent cobbles, and 5 percent soft fragments; very strongly acid; clear wavy boundary.

C-36 to 53 inches; variegated light yellowish brown and yellowish brown (10YR 6/4, 5/6) silty clay loam, yellow and brownish yellow (10YR 7/6, 6/8) dry; massive; sticky and slightly plastic; few very fine roots; common very fine tubular pores; 15 percent soft gravel; extremely acid; gradual wavy boundary.

Cr-53 inches; weathered siltstone.

The mean annual soil temperature is 47 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches thick. Depth to the paralithic contact is 40 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 18 to 25 percent. The horizon is 15 to 30 percent gravel and 0 to 5 percent cobbles.

The AB horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4 when moist and, 4 or 5 when dry, and chroma of 2 or 3 when moist and 3 or 4 when dry. The content of clay is 20 to 25 percent. The horizon is 15 to 30 percent gravel and 0 to 5 percent cobbles.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 4 or 5 when moist or dry. The content of clay is 20 to 27 percent. The horizon is 15 to 35 percent rock fragments, of which 15 to 30 percent is hard gravel, 0 to 15 percent is hard cobbles, and 5 to 10 percent weathered soft siltstone gravel.

The C horizon has hue of 10YR, value of 5 or 6 when moist and 6 or 7 when dry, and chroma of 4 to 6 when moist or dry. The content of clay is 25 to 30 percent. The horizon is 15 to 45 percent soft siltstone gravel.

Svensen Series

The Svensen series consists of very deep, well drained soils in mountainous areas. These soils formed in colluvium derived from sandstone. Slopes are 3 to 90 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Svensen loam, 30 to 60 percent slopes, in a wooded area south of spur road off Pipeline Road, 2,800 feet west and 1,900 feet north of the southeast corner of sec. 25, T. 8 N., R. 9 W., Willamette Meridian:

O-3 inches to 0; needles, twigs, and leaves.
A1-0 to 8 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; moderate fine and very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; extremely acid; clear wavy boundary.
A2-8 to 17 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; very strongly acid; gradual wavy boundary.
Bw-17 to 38 inches; brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; very strongly acid; clear wavy boundary.
C-38 to 60 inches; variegated strong brown (7.5YR 4/6, 5/6) and light brownish .gray (10YR 6/2) fine sandy loam, strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/6), and very pale brown (10YR 7/3) dry;, massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperatures is less than ,9 degrees. The umbric epipedon is 10 to 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 15 to 20 percent. The horizon is extremely acid to strongly acid.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 2 to 5 when moist or dry. The content of clay is 20 to 30 percent. The horizon is extremely acid or very strongly acid.

The C horizon has variegated colors. It is loam, fine sandy loam, or sandy loam and is 15 to 25 percent clay. The lower part of the horizon is 0 to 35 percent soft sandstone gravel. The horizon is extremely acid or very strongly acid.

Templeton Series

The Templeton series consists of deep, well drained soils in mountainous areas. These soils formed in colluvium derived from siltstone. Slopes are 3 to 90 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 45 to 51 degrees F.

Typical pedon of Templeton silt loam, 3 to 30 percent slopes, off a spur road east of Twilight Road, 350 feet south and 340 feet west of the northeast corner of sec. 29, T. 8 N., R. 8 W., Willamette Meridian:

O-3 inches to 0; leaves, twigs, moss, and woody material.
Al -0 to 5 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 fine and very fine roots; many fine and very fine irregular pores; extremely acid; gradual smooth boundary.
A2-5 to 12 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate coarse and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many fine and very fine irregular pores; very strongly acid; clear wavy boundary.
Bw1-12 to 38 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and coarse roots; common fine and very fine tubular pores; very strongly acid; gradual smooth boundary.
Bw2-38 to 58 inches; dark yellowish brown and yellowish brown (10YR 4/4 and 5/6) silty clay loam, light yellowish brown and brownish yellow (10YR 6/4 and 6/6) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; very strongly acid; gradual wavy boundary.
Cr-58 inches; weathered siltstone.

The mean annual soil temperature is 47 to 52 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 20 inches. Depth to the paralithic contact is 40 to 60 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 18 to 27 percent. The horizon is 0 to 15 percent soft siltstone gravel.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 to 5 when moist and 5 or 6 when dry, and chroma of .4 or 6 when moist or dry. The content of clay is 25 to 35 percent. The content of soft siltstone gravel is 0 to 25 percent.

Tolany Series

The Tolany series consists of very deep, well drained soils in mountainous areas. These soils formed in colluvium derived from mixed material. Slopes are 3 to 30 percent. The mean annual precipitation is 70 to 90 inches. The mean annual air temperature is 41 to 45 degrees F.

Typical pedon of Tolany silt loam, 3 to 30 percent slopes, in a wooded area on the south side of Kelly Road, in the NE1/4NE1/4 of sec. 22, T. 7 N., R. 6 W., Willamette Meridian:

O1-2 inches to 0; leaves, needles, twigs, moss, and roots.
A-0 to 6 inches; dark reddish brown (5YR 3/3) silt loam, brown (7.5YR 5/4) dry; strong very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine and very fine roots; many very fine irregular pores; strongly acid; abrupt smooth boundary.
Bw1-6 to 12 inches; reddish brown (5YR 4/4) silt loam, light brown (7.5YR 6/4) dry; strong very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; many fine and very fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.
Bw2--12 to 25 inches; reddish brown (5YR 4/4) silt loam, light brown (7.5YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and very fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.
Bw3-25 to 42 inches; dark brown (7.5YR 4/4) silt loam, light brown (7.5YR 6/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common fine and very fine roots; many very fine tubular pores; very strongly acid; gradual smooth boundary.
BC-42 to 60 inches; dark brown (7.5YR 4/4) silt loam, light brown (7.5YR 6/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine tubular pores; very strongly acid.

The mean annual soil temperature is 42 to 46 degrees F.

The A horizon has hue of 7.5YR or 5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 to 4 when moist or dry. The content of clay is 10 to 15 percent.

The Bw horizon has hue of 7.5YR or 5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 4 when moist and 6 when dry. The content of clay is 15 to 25 percent. The horizon is 0 to 10 percent gravel and 0 to 5 percent cobbles.

The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 6 moist or dry. It is 0 to 10 percent gravel and 0 to 5 percent cobbles. Layers of gravelly to extremely gravelly material are below a depth of 40 inches in some pedons.

Tolke Series

The Tolke series consists of very deep, well drained soils on mountaintops. These soils formed in mixed loess, ash, and colluvium. Slopes are 3 to 30 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 45 to 49 degrees F.

Typical pedon of Tolke silt loam, 3 to 30 percent slopes, in a forested area about 50 feet east of logging road, in the NW1/4NW1/4SE1/4 of sec. 27, T. 4 N., R. 6 W., Willamette Meridian:

O1-3 to 2 inches; needles, leaves, roots, and twigs.
O2-2 inches to 0; partially decomposed needles, leaves, and roots.
A-0 to 4 inches; dark brown (7.5YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly. hard, friable, slightly sticky and slightly plastic; moderately smeary; 20 percent fine and medium concretions; many very fine roots; many very fine irregular pores; very strongly acid; clear smooth boundary.
BA-4 to 11 inches; dark brown (7.5YR. 3/4) silt loam, yellowish brown (10YR 5/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately smeary; 20 percent fine concretions; many very fine roots; many very fine irregular pores; very strongly acid; gradual smooth boundary.
Bw1-11 to 19 inches; dark brown (7.5YR 3/4) silt loam, yellowish brown (10YR 5/4) dry; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; 30 percent fine concretions; many very fine roots; many very fine irregular pores; strongly acid, clear wavy boundary.
Bw2-19 to 29 inches; dark brown (7.5YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; 10 percent fine concretions; common very fine roots; common very fine tubular pores; strongly acid; gradual smooth boundary.
Bw3-29 to 44 inches; strong brown (7.5YR 5/6) silty clay loam, very pale brown (10YR 7/5) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary; common very fine roots; common very fine tubular pores; very strongly acid; gradual smooth boundary. .
Bw4-44 to 60 inches; strong brown (7.5YR 5/6) silt loam, very pale brown (10YR 7/4) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; very strongly acid.

The mean annual soil temperature is 47 to 50 degrees F.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2

or 3 when moist or dry. Concretions range from 5 to 20 percent. The content of clay is 18 to 27 percent.

The BA and Bw horizons have hue of 7.5YR or 10YR, value of 3 to 6 when moist and 5 to 8 when dry, and chroma of 4 or 6 when moist or dry. The content of concretions is 10 to 30 percent. The content of clay is 20 to 35 percent.

Treharne Series

The Treharne series consists of very deep, moderately well drained soils on stream terraces. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 51 inches.

Typical pedon of Treharne silt loam, 0 to 3 percent slopes, in an area of pasture; 600 feet east of the lane to Riverbend Ranch, off Bay Road; in the NW1/4NW1/4 of sec. 28, T. 5 N., R. 7 W., Willamette Meridian:

Ap-0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and medium irregular pores; very strongly acid; clear smooth boundary.

A2-7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure parting to fine and very fine granular; slightly hard, friable; slightly sticky and slightly plastic; many fine and very fine roots; many fine and medium irregular pores; very strongly acid; clear wavy boundary.

AB-14 to 20 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine tubular pores; very strongly acid; gradual wavy boundary.

Bt1-20 to 32 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; dark brown (10YR 4/2) and dark yellowish brown (10YR 4/6) mottles; moderate medium and fine subangular blocky structure; hard, friable to firm, sticky and slightly plastic; common fine and very fine roots; many very fine tubular pores; common thin clay films on ped faces and in pores; very strongly acid; clear wavy boundary.

Bt2-32 to 50 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; common medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, friable to firm, sticky and slightly plastic; common fine and very fine roots; many very fine tubular pores; common thin clay films on ped faces and in pores; very strongly acid; clear wavy boundary.

BC-50 to 60 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; very strongly acid; clear wavy boundary.

C-60 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; many medium prominent light gray (2.5Y 7/2) and strong brown (7.5YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; common fine tubular pores; very strongly acid.

The mean annual soil temperature is 49 to 52 degrees F. The umbric epipedon is 10 to 20 inches thick, but it commonly is 15 to 20 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. The content of clay is 15 to 25 percent.

The Bt horizon has value of 4 or 5 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. The content of clay is 18 to 35 percent. Mottles that have chroma of 2 are in the upper 10 inches of the argillic horizon, but they commonly are between depths of 24 and 30 inches.

The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 18 to 45 percent. Mottles are common to many and faint to distinct.

Tropaquepts

Tropaquepts are very deep, somewhat poorly drained and poorly drained soils on narrow stream terraces. These soils formed in mixed alluvium. Slopes are 0 to 20 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F:

Reference pedon of Tropaquepts in an area of Humitropepts-Tropaquepts complex, 0 to 20 percent slopes, in an area of woodland; about 150 feet north of Lewis and Clark mainline road; in the NW1/4SW1/4SW1/4 of sec. 25, T. 6 N., R. 9 W., Willamette Meridian:

A1-0 to 2 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; extremely acid; clear smooth boundary.

A2-2 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine,

roots; many very fine irregular pores; extremely acid; clear smooth boundary.

AB-7 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; extremely acid; clear smooth boundary.

Bw1-11 to 21 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; many very fine prominent yellowish red (5YR 4/6) mottles and many very fine faint yellowish brown (10YR 5/4) mottles; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; extremely acid; gradual smooth boundary.

Bw2-21 to 39 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; many very fine prominent yellowish red.(5YR 4/6) mottles; moderate fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine roots; few very fine tubular pores; extremely acid; gradual smooth boundary.

BC-39 to 54 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; many very fine prominent yellowish red (5YR 5/8, 4/6) mottles; weak very fine subangular blocky structure; hard, firm, sticky and slightly plastic; few very fine roots; few very fine tubular pores; very strongly acid; clear smooth boundary.

Cg-54 to 60 inches; dark bluish gray (5B 4/1) silty clay loam, light gray (2.5Y 7/2) dry; many very fine prominent dark yellowish brown (10YR 4/6) mottles; massive; hard, firm, sticky and slightly plastic; few very fine roots; few very fine tubular pores; medium acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or less when moist or dry. The content of clay is 18 to 25 percent.

The B horizon has hue of 10YR or 2.5Y, value of 5 or 6 when moist and 6 or 7 when dry, and chroma of 2 or less when moist or dry. The content of clay is 25 to 35 percent. The content of rock fragments is 0 to 50 percent.

The C horizon has hue of 2.5Y to 513, value of 4 to 6 when moist and 6 or 7 when dry, and chroma of 2 or less when moist or dry. The content of clay is 15 to 35 percent. The content of rock fragments is 0 to 70 percent.

Tropofluvents

Tropofluvents are deep and very deep; moderately well drained to excessively drained soils on flood plains. These soils formed in stratified alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Reference pedon of Tropofluvents, 0 to 3 percent slopes, in a young stand of alder along the North Fork Klatskanine River; near first parking lot east of Oregon Highway 202 and junction of Youngs River Loop; in the SW1/4NE1/4NW1/4 of sec. 18, T. 7 N., R. 8 W., Willamette Meridian:

A-0 to 5 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate very fine subangular blocky parting to fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine irregular pores; extremely acid; abrupt smooth boundary.

2C-5 to 10 inches; dark yellowish brown (10YR 4/4) sandy loam, light yellowish brown (10YR 6/4) dry; single grain; loose; common fine roots; common fine irregular pores; extremely acid; abrupt wavy boundary.

3C-10 to 15 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common very fine tubular pores; extremely acid; abrupt wavy boundary.

4C-15 to 60 inches; stratified gravel, cobbles, and sand.

The mean annual soil temperature is 50 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to bedrock is 40 to 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. The content of clay is 15 to 20 percent. The content of rock fragments is 0 to 30 percent.

The C horizon has value of 4 or. 5 when moist and 6 or 7 when dry, and it has chroma of 3 to 6 when moist or dry. The content of clay is 5 to 20 percent. The content of rock fragments is 0 to 85 percent.

Tropopsamments

Tropopsamments are very deep, excessively drained soils along the Columbia River. These soils formed in stratified dredge spoils. Slopes are 0 to 15 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Reference pedon of Tropopsamments, 0 to 15 percent slopes, southwest of Astoria Sewage Treatment Facility,

in the NE1/4NE1/4NE1/4 of sec. 10, T. 8 N., R. 9 W., Willamette Meridian:

AC-0 to 2 inches; very dark gray (10YR 3/1) sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic; many very fine roots; medium acid; clear smooth boundary.
2C-2 to 60 inches; dark gray (10YR 4/1) sand, gray (10YR 6/1) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; slightly acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter temperature is less than 9 degrees. The AC horizon is 1 to 3 inches thick. The content of coarse fragments is 0 to 30 percent throughout.

Udifluvents

Udifluvents are deep and moderately deep, moderately well drained to somewhat excessively drained soils on flood plains. These soils formed in stratified alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 90 inches. The mean annual air temperature is 48 to 51 degrees F.

Reference pedon of Udifluvents in an area of Udifluvents-Hapludalfs complex, 0 to 15 percent slopes; west of the junction of Wage Road, Stanley Creek Road, and Buster Creek Road, in the SE1/4NW1/4SE1/4 of sec. 20, T. 5 N., R. 6 W., Willamette Meridian:

A-0 to 8 inches; dark brown (7.5YR 3/2) loam, brown (7.5YR 5/2) dry; weak fine subangular blocky structure parting to moderate very fine granular; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine irregular pores; 5 percent gravel; very strongly acid; clear smooth boundary.
AC-8 to 14 inches; dark brown (7.5YR 3/4) silt loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; many fine irregular pores; 10 percent gravel; very strongly acid; abrupt wavy boundary.
C1-14 to 30 inches; dark brown (7.5YR 3/4) very gravelly loam, brown (7.5YR 5/4) dry; massive; soft, very friable,- nonsticky and nonplastic; common fine roots; common fine irregular pores; 45 percent gravel; extremely- acid; clear wavy boundary.
C2-30 inches; extremely gravelly sand; 85 percent gravel.

The mean annual soil temperature is 49 to 53 degrees F. Depth to bedrock is 40 to 60 inches or more. The umbric epipedon is less than 10 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 12 to 18 percent. The content of rock fragments is 0 to 40 percent.

The AC horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 4 when moist or dry. The content of clay is 12 to 18 percent. The content of rock fragments is 0 to 60 percent.

The C horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 4 or 6 when moist or dry. The content of clay is 5 to 18 percent. The content of rock fragments is 0 to 85 percent or more.

Udipsamments

Udipsamments are very deep, excessively drained soils along the Columbia River. These soils formed in stratified dredge spoils. Slopes are 0 to 15 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 48 to 52 degrees F.

Reference pedon of Udipsamments, 0 to 15 percent slopes, about 0.5 mile southeast of Wauna Mill; in the SE1/4NW1/4SE1/4 of sec. 26, T. 8 N., R. 6 W., Willamette Meridian:

AC-O to 2 inches; dark grayish brown (10YR 4/2) sand, grayish brown dry; single grain; loose; common very fine roots; 10 percent gravel; strongly acid; gradual smooth boundary.
C1-2 to 14 inches; dark gray (10YR 4/1) sand, gray (10YR 6/1) dry; single grain; loose; common very fine roots; 10 percent-gravel; medium acid; gradual smooth boundary.
C2-14 to 60 inches; gray (10YR 5/1) sand, light gray (10YR 7/1) dry; single grain; loose; few very fine roots; 5 percent gravel; medium acid.

The mean annual soil temperature is 49 to 53 degrees F. The underlying dredge spoils are 40 inches to more than 30 feet thick. The content of pumice gravel is 0 to 30 percent. Finer textured material is at a depth of more than 40 inches in some pedons.

The AC horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The C horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 1 or less when moist or dry.

Waldport Series

The Waldport series consists of very deep, excessively drained soils on stabilized sand dunes. These soils formed in dune sand. Slope is 3 to 30 percent. The mean annual precipitation is about 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Waldport fine sand, 3 to 15 percent slopes, in an area of grassland; north of Del Mar Beach Road and west of Neacoxie Creek, in the NE1/4NE1/4 of sec. 33, T. 7 N., R. 10 W., Willamette Meridian:

A1-0 to 3 inches; very dark brown (10YR 2/2) fine sand, grayish brown (10YR 5/2) and light gray (10YR 7/1) dry; weak fine subangular blocky structure; very friable, nonsticky and nonplastic;. many very fine, fine, and medium roots; many fine irregular pores; very strongly acid; clear wavy boundary.
A2-3 to 5 inches; dark brown (10YR 3/3) fine sand, pale brown (10YR 6/3) dry; single grain; loose; many very fine, fine, and medium roots; many fine irregular pores; strongly acid; clear wavy boundary.
C1-5 to 15 inches; pale brown (10YR 6/3) fine sand, light gray (10YR 7/2) dry; single grain; loose; many very fine, fine, and medium roots; many fine irregular pores; strongly acid; gradual smooth boundary.
C2-15 to 60 inches; light brownish gray (10YR 6/2) fine sand, light gray (10YR 7/1) dry; single grain; loose; common fine roots; many fine irregular pores; medium acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist and 1 to 3 when dry. The content of clay is 1 to 5 percent.

The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 6 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist and 1 or 2 when dry. The content of clay is 1 to 5 percent.

Walluski Series

The Walluski series consists of very deep, moderately well drained soils on terraces. These soils formed in silty alluvium. Slopes are 0 to 20 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 52 degrees F.

Typical pedon of Walluski silt loam, 0 to 7 percent slopes, in a wooded area, about 500 feet west of Lewis and Clark Road, in the SW1/4SW1/4NW1/4 of sec. 17, T. 7 N., R. 9 W., Willamette Meridian:

O-1 inch to 0; loose litter of needles, twigs, leaves, and moss.
A1--0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many medium and fine irregular pores; extremely acid; clear wavy boundary.
AB-7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; extremely acid; gradual wavy boundary.
Bw1-14 to 21 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and slightly plastic; many fine and medium roots; common very fine tubular pores; extremely acid; clear wavy boundary.
Bw2-21 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; common fine and very fine tubular pores; extremely acid; clear wavy boundary.
Bw3-31 to 47 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; many fine and medium distinct light gray (10YR 6/1) . mottles and many medium prominent strong brown (7.5YR 5/6, 5/8) mottles; moderate fine prismatic structure; hard, firm, sticky and plastic; few fine and medium roots; common very fine tubular pores; extremely acid; clear wavy boundary.
2BC-47 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (10YR 7/1) dry; many medium and coarse distinct gray (10YR 5/1) stains and many .fine and medium prominent yellowish red (5YR 5/6) and yellowish brown (10YR 6/8) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few very fine tubular pores; extremely acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. Depth to mottles is 20. to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The content of clay is 18 to 27 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. The content of clay is 22 to 35 percent. Chroma of 2 or less when moist is below a depth of 30 inches.

The 2BC horizon has hue of 10YR or 2.5Y, value of 5 or 6 when moist and 6 or 7 when dry, and chroma of 1 or 2 when moist of dry. The content of clay is 27 to 45 percent.

Warrenton Series

The Warrenton series consists of very deep, very poorly drained soils on long, narrow interdunal areas. These soils formed in sand. Slope is 0 to 3 percent. The mean annual precipitation is 70 to 100 inches. The mean annual air temperature is 48 to 51 degrees F.

Typical pedon of Warrenton loamy fine sand, 0 to 3 percent slopes, in a brushy and wooded area; 100 yards up private driveway along the second swale east of U.S. Highway 101, on Dellmoor Road; in the SE1/4SW1/4 of sec. 27, T. 7 N., R. 10 W., Willamette Meridian:

O-3 inches to 0; black (N 2/0) muck consisting of twigs, roots, needles, and leaves.
A-0 to 11 inches; black (N 2/0) loamy fine sand; many fine and medium prominent dark reddish brown (5YR 3/4) and reddish brown (5YR 4/4) mottles; many reddish brown (5YR 4/4) softly cemented linings along root channels; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine irregular pores; strongly acid; abrupt smooth boundary.
Cg1-11 to 22 inches; very dark gray (2.5Y 3/0) loamy fine sand; many fine, medium, and large prominent dark reddish brown (5YR 3/4), reddish brown (5YR 4/4), and yellowish red (5YR 4/6) mottles; massive; slightly hard, friable, nonsticky and nonplastic; few fine roots; many very fine tubular pores; very strong acid; abrupt smooth boundary.
Cg2-22 to 60 inches; very dark gray (2.5Y 3/0) fine sand; few fine and medium prominent reddish brown (5YR 3/4) mottles; single grain; loose; very strongly acid.

The mean annual soil temperature is 49 to 53 degrees F. The difference between the mean summer and mean winter soil temperature is less than 9 degrees. The umbric epipedon is 10 to 15 inches thick. The content of clay is 5 to 10 percent. Under natural conditions, the O horizon is 1 to 4 inches.

The A horizon has hue of 10YR to 5Y, value of 2 when moist or dry, and chroma of 0 to 2 when moist or dry.

The Cg horizon has hue of 5Y to 10YR, value of 3 or 4 when moist or dry, and chroma of neutral to 2 when moist or dry.

Wauna Series

The Wauna series consists of deep, poorly drained soils on flood plains influenced by tides. These soils formed in alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 60 to 80 inches. The mean annual air temperature is 49 to 52 degrees F.

Typical pedon of a Wauna silt loam in an area of Wauna-Locoda silt loams, protected, 0 to 3 percent slopes, east of Westport, in the NE1/4NW1/4SE1/4 of sec. 36, T. 6 N., R. 8 W., Willamette Meridian:

Ap-0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine irregular pores; many very fine and fine roots; very strongly acid; clear smooth boundary.
AC-9 to 18 inches; dark grayish brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; common fine prominent strong brown (7.5YR 4/6) mottles; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.
Cg1-18 to 34 inches; grayish brown (2.5Y 5/2) silt loam, light grayish brown (10YR 5/3) dry; common medium prominent strong brown (7.5YR 5/6) mottles; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; very strongly acid; clear smooth boundary.
Cg2-34 to 60 inches; gray (5Y 5/1) silt loam, light gray (2.5Y 7/2) dry; common medium prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, sticky and slightly plastic; few very fine roots; many very fine tubular pores; strongly acid.

The mean annual soil temperature is 50 to 53 degrees F.

The A and AC horizons have value of 2 or 3 when moist and 5 or 6 when .dry, and they have chroma of 1 or 2 when moist or dry. The content of clay is 15 to 22 percent.

The Cg horizon has hue of 2.5Y or 5Y, value of 4 or 5 when moist .and 6 or 7 when dry, and chroma of 1 or 2 when moist or dry. The content of clay is 10 to 35 percent. Chroma of 1 when moist is below a depth of 30 inches.

Formation of the Soils

Dr. R. B. Parsons, research soil scientist, Soil Conservation Service, mapped geomorphic surfaces in Clatsop County and helped to prepare this section.

Soil consists of layers of mineral and organic matter on the surface of the earth. Soil is formed by the interaction of five basic factors-climate, living organisms, parent material, topography, and time (15). The physical and chemical processes that result from the interaction of these factors determine the characteristics and properties of a soil. The influence of any one of these factors varies from place to place, but the interaction of all the factors determines the type of soil that forms.

Soil formation in Clatsop County has been greatly influenced by climate. Moist marine air moving inland from the Pacific Ocean moderates extremes of air and soil temperature in winter and summer. Because of this there is an area in Clatsop County, termed the isomesic zone or fog belt, that has the longest growing season (fig. 16). Farther inland, the direct influence of moist marine air diminishes and -the extremes in air and soil temperature increase, which results in a shorter growing season.

The characteristics of the parent material greatly influence the kinds of soil that form. Soils that formed in colluvium derived from volcanic material in the Coast Range have properties such as low bulk density, high liquid limit, and low plasticity. Soils that formed in colluvium derived from marine sediment such as that of siltstone have higher bulk density, lower liquid limit, and higher plasticity. The period of time parent material has been in place influences the kinds of soil that have formed. Soils that formed in recent alluvium on flood plains have characteristics such as a weak cambic horizon and an irregular decrease in organic carbon content throughout the profile. Soils that formed in older alluvium on terraces have characteristics such as a strong cambic horizon and a regular decrease in organic carbon content throughout the profile. In some areas an argillic horizon has formed in soils on terraces.

In this section the factors of climate and living organisms are discussed together. The factors of time, topography; and parent material are also discussed together in the section "Geomorphic Surfaces and Soil Development." Finally, the geology of volcanic and sedimentary material is discussed.

Climate and Living Organisms

Climate has a strong influence on soil formation. Temperature and moisture influence the kind of vegetation that grows in an area and its rate of growth. Temperature and moisture also influence decay of organic matter, weathering of minerals, and removal of material from one soil horizon and accumulation in another.

Living organisms are an active factor in soil formation, and the changes they bring about depend on the life processes peculiar to each. The kinds of organisms that live on and in the soil are determined by climate, topography, age of the soil, and parent material.

Plants actively influence soil formation by providing a root system and cover for holding soil particles- together to resist erosion. Leaves, twigs, roots, and the remains of entire plants that accumulate on the surface of soils are decomposed by the actions of animals, insects, and micro-organisms, which helps to return valuable organic matter to soils. Plant roots also widen cracks in the underlying rock, allowing water to penetrate. The uprooting of trees by wind mixes soil layers, loosens the underlying material, and brings weathered rock and mineral material to the surface.

In Clatsop County there are three major soil climatic areas: (1) Those that have cool, wet winters and cool, moist summers; (2) those that have cold, wet winters and warm, moist summers; and (3) those that have cold, wet winters and cool, moist summers. Areas that have cool, wet winters and cool, moist summers are considered to be in the fog belt. Fog belt is a general term for the area that is influenced by fog, low clouds, and cool, moist air in summer. The fog belt in Clatsop County is quite extensive. It extends roughly from the Pacific Ocean in the west to the Nehalem River in the east, and from the Nehalem River at the Clatsop County line in the south, north to Aldrich Point just east of Knappa and Brownsmead, and west from Aldrich Point to the mouth of the Columbia River.

Elevation of the fog belt area ranges from 0 to 1,600 feet. The soils in this area have an udic soil moisture regime and an isomesic temperature regime (19). Figure 17 gives soil temperature data as recorded in areas in this temperature regime. Native vegetation in the fog belt is within the Picea sitchensis zone, as described by Franklin and Dyrness (7). The plant community consists

Figure 16.-Summer fog in the Necanicum River Valley.

primarily of conifers such as Sitka spruce and western hemlock. Red alder is the most abundant hardwood tree in more recently disturbed areas. Abundant moisture and modified air and soil temperatures in the fog belt result in a long growing season that promotes a large accumulation of organic matter. High rainfall in the fog belt has resulted in the existence of a nearly continuous leaching environment, which has promoted extensive leaching of bases and low base saturation. Conifers absorb bases but do not readily return them to the soil, which also contributes to the low base status of soils that formed under these conditions. Dystrandepts such as Klootchie soils and Humitropepts such as Templeton soils are examples of soils that formed under these conditions in the fog belt.

In the eastern part of the county, winters are cool and moist and summers are warm and moist. Soils in this area have an udic moisture regime and a mesic soil temperature regime (19). Native vegetation in the mesic area is within the Tsuga heterophylla zone (7). The plant community is primarily conifers and includes western hemlock, Douglas-fir, and western redcedar. Red alder is the most abundant hardwood tree in the more recently disturbed areas. Precipitation generally is high in winter. The direct moderating effects of cool, moist marine air diminish in terms of air and soil temperature. The

Site name	Elevation	Mean soil temperature		
		Annual	Summer	Winter
	Ft	°F	°F	°F
Crown Zellerbach[1]	100	51	54	48
Crown Zellerbach[1]	500	49	52	46
Crown Zellerbach[1]	1,000	47	51	44
Ecola Park[1]	200	51	55	48
Tillamook Head[1]	1,100	47	50	43
Necanicum River[2]	500	49	53	46
Saddle Mountain[2]	1,000	48	51	44
Gnat Creek[2]	200	49	53	45

Figure 17.-Soil temperature in the isomesic zone. "Summer" refers to June-August; "winter," December-February. A "1" in the "Site name" column indicates data were collected in the period 1978-83; a "2," In the period 1979-83.

difference in soil temperatures between summer and winter is more than 9 degrees F. The growing season is somewhat shorter than that in the fog belt, and the soils dry out more in summer. Organic matter accumulations are thick enough to allow an umbric epipedon to form in most of the soils, but the percentage of organic matter is less than that in the soils of the fog belt. High precipitation in winter results in extensive leaching of bases and in low base saturation. Haplumbrepts such as Rinearson soils and Dystrandepts such as Hemcross soils formed in this area. In the mesic area, along the Clatsop and Columbia County lines, precipitation decreases to the smallest amount in the county. Accumulation of organic matter is less; and more organic matter is lost through oxidation. Precipitation is sufficient to leach bases from soils, which results in generally low base saturation. Entic Dystrandepts such as Anunde soils and Dystrochrepts such as Scaponia soils formed in this lower rainfall area.

At elevations above 1,600 feet, winters are cold and wet while summers are cool and moist. Soils that formed in these areas have an udic moisture regime and a frigid or cryic soil temperature regime (19). Native vegetation is that of the *Tsuga heterophylla* and *Abies amabalis* zones (7).

The native vegetation is primarily conifers such as western hemlock, Douglas-fir, Pacific silver fir, and noble fir. Precipitation is high in winter. Snow may cover the area for short periods between December and March. On north and east aspects at the higher elevations, show may remain for as much as several weeks. In summer the soils dry out at the higher elevations for brief periods. The growing season in these areas is the shortest in the county. Timber growth is slower. Accumulation and decomposition of organic matter are sufficient to form an umbric epipedon in most areas. High precipitation results in substantial leaching of bases. Under these conditions, Dystrandepts such as Murtip and Caterl soils and Cryumbrepts such as Newanna soils formed.

Organisms such as insects, fungi, earthworms, micro-organisms, and burrowing animals actively influence the formation of soils. These organisms accelerate the decomposition of organic matter by breaking down the remains of plants. Insects, micro-organisms, and earthworms feed on plant remains on the surface and on organic matter in the upper few inches of soil. They slowly but continually alter the physical and chemical properties of organic matter and aid in mixing it with mineral material. Small animals burrow into the soil seeking shelter, which results in the mixing of soil layers.

Temperature and moisture greatly influence the activity and abundance of insects, animals, soil microbes, and fungi.

Geomorphic Surfaces and Soil Development

Geomorphic surfaces consist of a landform or group of landforms that represent an episode of landscape development (3). These surfaces, or units, have been extensively studied and mapped along the Willamette Valley by Parsons and others (3, 14). Radiocarbon dating has provided several age dates for alluvium underlying middle to early Holocene surfaces in the Willamette Valley (3). These dates have helped to establish a time sequence of geomorphic surfaces in the Willamette Valley (3). Geomorphic surfaces have been studied and mapped in Multnomah (15) and Columbia Counties. Geomorphic surfaces have been studied along the southern Oregon Coast by Parsons and others (11). Palmer (12) also has studied terraces along the Pacific Coast in order to determine whether or not these terraces could be correlated regionally. These studies help to confirm and substantiate the regional occurrence of geomorphic surfaces in Oregon and are used to correlate the surfaces that Parsons mapped in Clatsop County.

In general, the major result of these studies is a relationship that shows increasing soil development with increasing age of landscapes. The kind of soil associated with a surface in this relationship is the result of the interaction of parent material, relief, climate, and living organism, as the time factor of soil genesis is considered a constant:

Geomorphic surfaces of Clatsop County were mapped on high-altitude aerial photographs (1 inch equals 1 mile) by Parsons. The surfaces were visually traced throughout the survey area. Sequential relationships

among the surfaces, stereoscopic observations, elevation, and photo interpretation of tonal patterns were used to map the surfaces. It was necessary to include smaller geomorphic surfaces into other surfaces because of the limitations of the mapping scale.

A sequence of surfaces recognized in Clatsop County in order of increasing age are Horseshoe, Ingram, Winkle, Senecal, Dolph, and Eola.

Also discussed, but not considered a geomorphic surface, is the Looney geomorphic mapping unit, which consists of steep, broken topography of the Coast Range. Steep slopes of the Looney unit also connect the Senecal, Dolph, and Eola geomorphic surfaces. Because of the variability in landscape stability in the Looney unit, the soils and surfaces fit no particular span of time:

Geomorphic surfaces recognized in Clatsop County correlate with surfaces recognized in the Willamette Valley (3) and those recognized along the southern Oregon Coast (11). Radiocarbon dating of peat samples taken by Rankin (16) indicates ages of 275 to 4,000 years for materials! underlying the Ingram surface in Clatsop County. Radiocarbon dates measured in the Willamette Valley for samples underlying the Ingram surface indicate ages of 550 to 3,290 years (3). These dates suggest that there is a reasonable correlation between the age of materials underlying and associated with the Ingram surface and the age of adjacent surfaces of the Willamette Valley and Clatsop County. Studies along the southern Oregon Coast by Nettleton and others (11) and by Parsons and Haagan have also correlated coastal geomorphic surfaces with Willamette Valley surfaces. In the southern Oregon Coast studies, different surface names were used, but they are considered to be coastal equivalents of many of the Willamette Valley surfaces (11). More extensive studies and dating of coastal areas will further substantiate the correlation of the geomorphic surfaces in these areas with many of those in the Willamette Valley.

Horseshoe surface.-The Horseshoe surface generally is considered to be the lower of the two flood plains in the survey area. It has low relief and includes the stream channel and associated features, such as point bar deposits, channel fillings, abandoned meanders, tidal flats, and beaches associated with the Pacific Ocean. Active sand dunes are also mapped as the Horseshoe surface in Clatsop County. The Horseshoe surface generally is underlain by sand, gravel, cobbles, and stones. Sand and finer textured materials underlie the surface along tide influenced areas. Many areas of the Horseshoe surface support sparse young stands of alder, willows, and other. water loving plants. Other areas are too active to support any vegetation. Active dunes are barren or only support stands of beachgrass.

Except for the dunes, annual flooding or daily tidal fluctuations inundate this surface. Rapid changes in the Horseshoe landscape result from the cutting of new channels, abandonment of older channels, migration of meanders, and the downstream movement of alluvium. 'The Horseshoe surface began to form only a short time ago, as is evidenced by the presence of metallic artifacts in the alluvium associated with this surface.

Soils that formed in the sediment associated with the Horseshoe surface include Histic Tropaquepts such as Clatsop soils and Typic Fluvaquents such as Locoda soils. Accumulation of organic matter has resulted in the formation of an ochric epipedon, but other diagnostic horizons have not had time to form. The Clatsop soils exhibit enough accumulation of organic matter to have formed a histic epipedon. Clatsop and Locoda soils are presumed to exhibit irregular decreases in organic carbon content throughout the profile, which results from the variable nature of recent alluvial deposits. Clatsop soils are nonacid in their natural state because of the influence of seawater mixing with freshwater and the effect on the water table in the soil. Clatsop soils that have been diked and drained are acid.

Other soils that formed in the sediment associated with this surface include Typic Psammaquents such as Heceta soils. Heceta soils exhibit a thin, dark-colored surface layer because of the accumulation of organic matter. No other diagnostic horizons have formed in these soils because of their recent age.

Areas of the Horseshoe surface along smaller streams have been included in the Ingram surface because of limitations imposed by the mapping scale.

Ingram surface.-In this survey area the Ingram surface is a higher flood plain of late Holocene age. Topography of the Ingram surface typically is undulating, with as much as 10 feet of relief produced by overbank channeling at flood stage in some areas, such as along the Nehalem River, and as little as 2 feet of relief in tide influenced areas, such as along the Columbia River. The Ingram surface generally becomes broader as stream gradients decrease, and it reaches its maximum extent along tide influenced areas. Low stream gradient, tidal influence, and broad surface area to dissipate flood water results in minimal relief being expressed on the Ingram surface. Alluvium underlying the Ingram surface consists of sand, gravel, and cobbles in the upper stream system, and it becomes finer textured downstream. Stable dune landforms are also included in the Ingram landscape.

Soils that formed in material of the Ingram surface generally exhibit organic matter accumulation in the surface layer, a cambic horizon, and an irregular decrease of organic carbon content throughout the profile: Fluventic Humitropepts such as Nehalem soils and Fluventic Haplumbrepts such as Kirkendall soils are typical of soils that formed on natural levee and bar landforms of the Ingram surface. Both soils exhibit an umbric epipedon and a cambic horizon. Nehalem soils are in the fog belt. Aeric Tropaquepts such as Brenner and Nestucca soils formed in the channels and backswamps of the Ingram surface. These soils exhibit

an umbric epipedon, a cambic horizon, gleying, and mottling. Gleying and mottling indicate the mobility of ferrous iron under the variable reducing and oxidation conditions associated with a fluctuating water table. McNulty soils formed in loamy alluvium on the slightly lower bar positions nearest the stream. These soils do not have an umbric epipedon, but they do have a weak cambic horizon.

Soils that formed in silty alluvium associated with the Ingram surface along the Columbia River include Aeric Tropic Fluvaquents such as Coquille soils and Aeric Fluvaquents such as Wauna soils. Both soils are inundated by high tides or peak runoff, or both. They do not have an umbric epipedon or a cambic horizon. Gleying and mottling are evident. Coquille soils are in the fog belt and are nonacid in their natural state; if diked and drained, these soils become acid.

Other soils associated with the Ingram surface include Typic Tropopsamments such as Waldport soils, Typic Tropaquepts such as Warrenton soils, and Tropohemists such as Brallier and Bergsvik soils. Waldport soils formed in recently stabilized dune sand and do not have an umbric epipedon or a cambic horizon. Warrenton soils have a thick, dark-colored umbric epipedon but do not have a cambic horizon. They formed in sandy material along stable interdunal swales. Brallier and Bergsvik soils have a histic epipedon. Bergsvik soils formed in organic material overlying sand, while Brallier soils formed in thick organic deposits. Both soils formed in wet swales or interdunal areas.

Coquille, Wauna, Waldport, and Warrenton soils represent the youngest soils associated with the Ingram surface in the survey area.

Winkle surface.-The middle to early Holocene Winkle surface is related to the present drainage systems of western Oregon (14). The continuity provided by geomorphic mapping from the Willamette Valley, down the Columbia River to Clatsop County, confirms the correlation of surfaces. In the Willamette Valley, radiocarbon dating of material underlying the Winkle surface showed that it ranges from 5,250 to 12,240 years in age. It is assumed that the sediment from the Winkle surface in Clatsop County falls within this range, because the maximum age of material from the Ingram surface, the next younger surface, was measured at 4,000 years, which approaches the minimum age of the Winkle surface.

Most of the Winkle surface reflects bar and channel topography, with a well defined backswamp in some areas. The relief between the bars and channels results largely from the competence of the stream that flowed through the area. Bar and channel topography is most distinctly expressed along the Nehalem River. Along smaller stream systems, such as those of the Klatskanine, Lewis and Clark, and Necanicum Rivers, the surface is narrower and expresses less relief between bars and channels. As the tidewater is approached, the Winkle surface is not present because of erosion by streams or because of the drowning of the Winkle surface by the alluvium associated with the Ingram surface. Sediment associated with the Winkle surface is dominated by silt and clay and commonly is underlain by gravel or sand at a depth of 2 to 6 feet. The alluvium may have amorphous material in the surface layer. Older stable dune landforms are also among the Winkle surfaces in the survey area.

Soils that formed in the alluvial sediment associated with the Winkle surface generally have a well expressed umbric epipedon, a cambic horizon, or a weakly expressed argillic horizon. All of these characteristics reflect greater development when compared to soil development on the Ingram surface in Clatsop County. Typic Dystrandepts such as Mues soils and Haplic Andaquepts such as Croquib soils are typical of soils that formed in the part of the Winkle surface that is in the isomesic zone. Mues and Croquib soils formed in alluvium containing a significant amount of amorphous material that is underlain by weakly to strongly consolidated gravelly alluvium. The source of the amorphous material is presumed to be from the erosion of Miocene basalt in the mountains. During the formation of the Winkle surface, extensive erosion and downcutting occurred in the county. Alluvium containing amorphous material is also associated with the part of the Winkle surface in the area that is along the fog belt in Tillamook County. Mues soils have a thick, dark-colored umbric epipedon and a cambic horizon. Croquib soils formed in backswamp areas, have low chroma, and exhibit gleying and mottling.

On the stable dune landform, Typic Dystropepts such as the Gearhart soils formed. These soils have a thick, dark-colored umbric epipedon and a cambic horizon, as is evidenced by hues of 5YR and 7.5YR. Iron accumulation is not enough to classify these soils into the order of Spodosols.

Other soils that formed in alluvium associated with the Winkle surface are those of the mesic area-Ultic Hapludalfs such as Eilertsen soils, Aquultic Hapludalfs such as Treharne soils, and Umbric Ochraqualfs such as Natal soils. These soils, which have a weakly expressed argillic horizon, are the youngest soils in the survey area to have an argillic horizon. Lower rainfall, drier periods in summer, and absence of influence from amorphous material may explain the formation of an argillic horizon in this area but not in the part of the survey area in the fog belt. Eilertsen and Treharne soils have an umbric epipedon, while Natal soils have a thin ochric epipedon. Eilertsen soils formed in silty alluvium on the higher bar positions. Treharne soils formed in slightly depressional areas and have low chroma mottles in the upper part of the argillic horizon. Natal soils formed in clayey alluvium in backswamp areas and have low chroma. Eilertsen, Treharne, and Natal soils are strongly leached and have

relatively low base saturation of 35 percent to somewhat less than 50 percent.

Senecal surface.-The Senecal surface occurs as terraces of intermediate elevation along most streams in the survey area. Senecal marine terraces also occur adjacent to the Pacific Ocean. Topography of the Senecal surface is variable throughout the survey area. The most extensive area of the surface, such as that mapped along the northern side of Youngs Bay, near the Walluski Loop intersection with Highway 202, exhibits low relief and slight incision by drainageways. Other less extensive areas have greater relief, with slopes of as much as 20 percent, and deeper incision by drainageways. The Senecal surface generally is adjacent to the Winkle surface, and it is considered to be the next higher surface. The minimum age for the Senecal surface must be more than the maximum age of the Winkle surface; therefore, its late Pleistocene age is reasonable. Holocene erosion has removed many areas of this late Pleistocene (14) surface, so only small remnants remain. The Senecal surface in some areas is directly above the Ingram surface, where erosion has removed the Winkle surface. Sedimentary material of the Senecal surface is dominated by silt and clay, but it includes loamy to sandy material in some areas. Soils of the Senecal surface generally are moderately well drained to poorly drained.

Soils that formed in material of the Senecal surface include Typic Humitropepts such as Walluski and Chitwood soils and Typic Tropaquepts such as Hebo soils. These soils are in the fog belt. They have an umbric epipedon and a distinct cambic horizon. Hebo and Chitwood soils formed in finer textured material. Hebo soils formed in the more nearly level to concave areas and exhibit low chroma, gleying, and mottling. Chitwood soils formed in gently sloping areas adjacent to the next higher terrace or on slightly higher positions adjacent to the Hebo soils. Chitwood soils have low chroma mottles near the surface. Walluski soils formed in less clayey material and have a thicker umbric epipedon.

Typic Haplohumults such as Elsie and Northrup soils formed in the mesic area. They have a well expressed umbric epipedon and an argillic horizon. Base saturation in the Elsie and Northrup soils is less than 35 percent. Northrup soils are mottled.

An argillic horizon has not formed in the isomesic zone in the survey area; however, the Senecal surface is old enough for the soils to have developed an argillic horizon. Explanations can be attributed to climatic factors, because the soil does not become thoroughly dry at any time during the year, and possibly to the amorphous minerology of the parent material that does not lend itself to eluviation. Clay eluviation occurs when a dry soil is wetted in fall and if the clay minerals are subject to translocation. Amorphous clay weathered from certain volcaniclastic material has neither the shape nor size to be eluviated, especially when complexed by organic matter or iron, or both.

Dolph surface.-The Dolph surface consists of nearly level to moderately sloping, deeply incised remnants of pediments, summits, and marine and stream terraces. Relative position above the main valley floor, the degree of dissection, and evidence of strongly weathered gravel underlying the surface in many areas suggest middle Pleistocene age for this surface (14). This surface is well expressed in the vicinity of Knappa and Svensen, near the Columbia River. The Dolph surface has silty and clayey deposits over partially weathered gravel or sedimentary bedrock: Weathered gravel generally is derived from local mountain sources and has been in place long enough to exhibit pronounced weathering rinds.

Soils that formed in material of the Dolph surface include Typic Humitropepts such as Grindbrook and Knappa soils. These soils have a well expressed, thick, dark-colored umbric epipedon and a thick, strongly developed cambic horizon. Grindbrook soils are mottled, but Knappa soils do not have mottles. Grindbrook soils that formed on the moderately sloping landform of the Dolph surface are underlain by weathered siltstone. Hebo soils typically formed on the Senecal surface; however, soils that appear similar to Hebo soils were mapped on the Dolph surface. These soils may be taxadjunct to the Hebo series.

The Dolph surface in the mesic area consists of very small remnants and have been included in the Senecal surface. The soils in this area are Typic Haplohumults.

Eola surface.-The Eola surface consists of erosional remnants of the oldest stable geomorphic surface in the survey area. Relief is moderate, and it generally consists of broad, gently rolling, and stable topography.

The Eola surface is considered to be early Pleistocene (14). Erosion during Pleistocene and Holocene times has removed much of this surface. Only-very small remnants remain in Clatsop County. Soils that formed in material of the Eola surface have been included in the stable slope soils of the Looney unit. The Eola surface in Clatsop County is typified by Typic Humitropepts where it occurs in the fog belt and Aquic Haplohumults where it occurs in the mesic area. Andic Humitropepts such as Templeton soils and Typic Humitropepts such as Svensen soils that are in these positions have developed an umbric epipedon and a thick cambic horizon. Aquic Haplohumults such as Mayger soils have an umbric epipedon and a relatively strong, thick argillic horizon. Mayger soils formed in clayey material and have low chroma mottles in the upper part of the argillic horizon. Base saturation is less than 35 percent in the Mayger soils.

A small area of gravel derived from the Troutdale Formation (14) underlies the part of the Eola surface that is mapped in the central part of the crest in Astoria. The formation consists of pebbles of quartzitic and acidic

volcanic composition set in a matrix of unconsolidated, poorly sorted, unbedded, sandy and clayey siltstone (17). Composition of these pebbles indicates a Columbia River source. These pebbles are similar to pebbles present in the Portland area; therefore, an early Pliocene age is tentatively assigned to the quartzitic gravel in Astoria (17).

Landforms of the Looney unit generally adjoin the Eola surface and join it to the lower lying younger surfaces. *Looney unit*.-The Looney unit has no particular age connotation and is not considered to be a geomorphic surface (3). Topography of the Looney unit is dominated by steep slopes. The Looney unit may join geomorphic surfaces, but generally it makes up large areas of rough, broken topography. Erosion is active on much of the unit, and landsliding and slumping are evident in many areas. The variability in age makes the Looney unit useful in mapping mountainous terrain. The unit could be mapped into several smaller geomorphic units if more detail were desired. These units would consist of slopes of different Holocene age, older stable slopes, and small alluvial systems.

Geology of Volcanic and Sedimentary Materials

Three significant gradient breaks have been recognized in the survey area, and these correspond to stable, metastable, and active slopes (13). In general, the youngest soils formed on the active slopes and the oldest soils formed on the stable slopes. Soils on the active slopes generally are shallow to bedrock, have a high content of rock fragments, and show the least amount of soil development. Soils on the stable slopes exhibit deeper profile development, fewer rock fragments, and greater depth to bedrock. Parent material influences topography, texture, and mineralogy. Any influence of volcanic ash in soil formation is unclear at this time. It is presently assumed that amorphous materials were derived from weathering of volcanic rock.

Volcanic formations in Clatsop County are primarily Miocene rock (17) and Eocene rock (5). The Miocene formations include Columbia River Basalt; as reported by Schlicker (17). Petrochemically, the Miocene basalts is indistinguishable from the Yakima Basalt. Structural and textural differences between these basalts resulted from the chilling effects of the seawater at the time of extrusion (17). Rocks of Miocene age include volcanic breccias and some pillow basalts. Volcanic rock of Eocene age is included in the Tillamook Volcanic Series and is included in the lower and upper Eocene basalt and upper Eocene volcanic and sedimentary rock as reported by Beaulieu (5). The Eocene volcanic rock is also included in the Tillamook Volcanic Series and is included as upper Eocene basalt. Beaulieu also reports that the Eocene volcanic unit is considered to be part of the Goble Formation (5). Rocks of Eocene age include submarine and subaerial basalt flows, tuffs, and tuff breccias.

Scattered throughout the county are intrusive bodies consisting of dikes and sills. The intrusive bodies are thought to be Miocene age and are closely related to Miocene volcanic rock (17).

Colluvium derived from volcanic rock in Clatsop County imparts distinctive characteristics to the soils that formed in it. Amorphous material dominates the exchange complex, organic carbon content generally is high, phosphorus retention is high, bulk density is low, liquid limit is high, plasticity index is low, and the water holding capacity is high.

Soil formation in volcanic parent material on stable slopes.-Soils that formed on the stable slopes are typified by Typic Dystrandepts and Entic Dystrandepts. Typic Dystrandepts such as Klootchie, Hemcross, and Murtip soils have an umbric epipedon, a thick cambic horizon, and a deep, relatively rock free profile. Klootchie soils formed in isomesic areas, Hemcross soils in mesic areas, and Murtip soils in frigid areas. Entic Dystrandepts such as Anunde, Tolke, and Tolany soils have an ochric epipedon and a thick, rock-free cambic horizon. Anunde and Tolke soils formed in mesic areas, and Tolany soils formed in frigid areas.

Soil formation in volcanic parent material on metastable slopes.-Soils that formed on metastable slopes are typified by Typic Dystrandepts and Entic Dystrandepts. Typic Dystrandepts such as Caterl, Klistan, and Necanicum soils have an umbric epipedon and a cambic horizon that is high in content of rock fragments. The Caterl soils formed in frigid areas, the Klistan soils in mesic areas, and the Necanicum soils in isomesic areas. Entic Dystrandepts such as the Alstony soils have an ochric epipedon and a cambic horizon that has a high content of rock fragments; these soils are in the drier mesic areas.

Soil formation in volcanic parent material on active slopes.-Soils that formed on active slopes are typified by Andic Humitropepts such as Ascar soils in isomesic areas; Typic Dystrandepts such as, Harslow soils and Lithic Haplumbrepts such as Kilchis soils in mesic areas; Typic Dystrandepts such as Laderly soils in frigid areas; and Andic Cryumbrepts such as Newanna soils in cryic areas. These soils have a high content of rock fragments throughout the profile, are relatively shallow to bedrock, and commonly are associated with rock outcroppings on the steeper active slopes. The soils have an umbric epipedon and a thin, weakly developed cambic horizon. Ascar soils generally have low bulk density in the upper part of the profile. Kilchis soils do not have low bulk density.

Sedimentary formations in the survey area primarily include Oligocene to Miocene sedimentary rock, Upper Miocene sandstone, and Eocene sedimentary rock that is undifferentiated (5). Among the formations of Oligocene to Miocene age is the Astoria Formation (17).

The Oligocene and Miocene sedimentary rocks are the most extensive strata in the county. The Astoria Formation consists primarily of siltstone with smaller amounts of sandstone and claystone. The upper Miocene sandstone unit is dominantly in the northern part of the county, near the Columbia River. This unit consists primarily of micaceous, medium grained to coarse grained, semiconsolidated arkosic sandstone (17, 5). The ,Eocene sedimentary rock is near the southeastern corner of the county and consists primarily of siltstone with smaller amounts of micaceous sandstone.

Soil formation in sedimentary parent material on stable slopes.-Soils that formed on stable slopes are typified by Andic Humitropepts such as Templeton soils and Typic Haplumbrepts such as Rinearson soils. Templeton and Rinearson soils have a distinct umbric epipedon, a thick cambic horizon, and a deep, relatively rock free profile. Templeton soils have low bulk density in the surface layer. Laboratory analyses would help to substantiate whether low bulk density is due to amorphous material or to organic matter, or to both. Templeton soils formed in the isomesic area, and Rinearson soils formed in the mesic area.

Soil formation in sedimentary parent material on metastable slopes.-Soils that formed on metastable slopes are typified by Andic Humitropepts such as Skipanon soils, Typic Humitropepts such as Svensen and Millicoma soils, Andic Haplumbrepts such as McMille soils, and Umbric Dystrochrepts such as Scaponia soils. McMille, Millicoma, Skipanon, and Svensen soils have an umbric epipedon and a cambic horizon. Millicoma soils have a high content of hard sedimentary fragments throughout the profile and are moderately deep to weathered bedrock. Skipanon soils formed in loamy colluvium derived from basalt, are underlain by siltstone, and generally have low bulk density in the upper part of the profile. Svensen soils formed in colluvium derived from sandstone and have a deeply weathered profile. Millicoma, Skipanon, and Svensen soils formed in the fog belt. McMille soils formed in frigid areas. In the drier part of the mesic area, Scaponia soils have an ochric epipedon with value of less than 4 when moist and a cambic horizon.

Soil formation in sedimentary parent material on active slopes.-Soils that formed on active slopes are typified by Andic Humitropepts such as Ecola soils and Dystric Eutrochrepts such as Braun soils. The Ecola and Braun soils have a moderately deep soil profile with soft sedimentary rock fragments in the profile. A cambic horizon has formed in these soils, but it generally is thin and weakly expressed. Ecola soils have an umbric epipedon and have low bulk density in the surface layer. Laboratory analyses would help to substantiate whether low bulk density is due to amorphous materials or organic matter, or to both. Ecola soils formed in isomesic areas. Braun soils have an ochric epipedon and a thin, weakly developed cambic horizon. Braun soils in Clatsop County are taxadjunct to the series and are presumed to have less than 60 percent base saturation (by ammonium acetate) in some subhorizon that is 10 to 30 inches below the soil surface, based on acid reaction measured throughout the profile in the field. Braun soils formed in the drier mesic areas.

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Glossary

Alluvial cone. The material washed down the sides of mountains and hills by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as-

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60. centimeters) in. diameter.

Breaks. The steep to very steep broken land at the border of an upland summit that is dissected by ravines.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter, in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

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 larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter. .

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35-to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are

Loose.-Noncoherent when dry or moist; does not hold together in a mass.

Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.-Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.-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.

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 that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine-grained soil material stabilized around shrubs or small trees.

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.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the standby its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.-These soils have very high and high hydraulic conductivity and low water . holding capacity. They are not suited to crop production unless irrigated. .

Somewhat excessively drained.-These soils have high hydraulic conductivity and low water holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.-These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.-These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils

commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.-These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly *drained.*-These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.-These soils are wet to the surface most of the time. They are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast Intake (in tables). The rapid movement of water into the soil.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, and clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of men and equipment in fire fighting. Designated roads also serve as firebreaks.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material. is more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (or 300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated `from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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 as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill -is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the Soil Survey Manual. The major horizons of mineral soil are as follows:

O horizon.-An organic layer of fresh and decaying plant residue.

A horizon.-The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

E horizon.-The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

C horizon.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are-

Border.-Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.-Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.-Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.-Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).-Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.-Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.-Water, released at high points, is allowed to flow onto an area without controlled distribution. .

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

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).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables-hue, value, and chroma. For example, a notation of 10YR 6/4 is a color in hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin: An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example*, hardpan, fragipan, claypan, plowpan, and traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting (in tables). Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the- content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction,, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as-

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5:6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Salty water (in tables.) Water that is too salty for consumption by livestock.

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.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a -clay deposit.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site class. A grouping of site indexes into 5 to 7 production capability levels. Each level can be represented by a site curve.

Site curve (50-year). A set of related curves on a graph that shows the average height of dominant trees for the range of ages on soils that differ in productivity. each level is represented by a curve. The basis of the curves is the height of dominant trees that are 50 years old or are 50 years old at breast height.

Site curve (100-year). A set of related curves on a graph that show the average height of dominant and codominant trees for a range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant and codominant trees that are 100 years old or are 100 years old at breast height.

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.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

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.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body-at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0:5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters), in length if flat.

Stony. Refers to a soil containing stones in numbers -that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are platy (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless soils* are either *single grained* (each grain by itself; as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically; the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts. Soils that cannot be classified in a series recognized, in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain,. ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam,* silty clay *loam, sandy clay,* silty *clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Windthrow. The action of uprooting and tipping over trees by the wind.