Series 1959, No. 37 Issued November 1964

SOIL SURVEY

Sherman County Oregon

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
OREGON AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Sherman County, Oreg., will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; and add to our knowledge of soil science.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers can learn about the soils in the section "Soil Descriptions" and then turn to the section "Use, Management, and Productivity of the Soils." In this way, they first identify the soils on their farms and then learn how these soils can be managed and what yields can be expected. Farmers who want information about management of native range can turn to the section "Range," where the soils used mainly for grazing have been placed in range sites. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county and the page of the report where each is described. It also lists, for each soil and land type, the capability unit and range site and the page where each of these is described.

Engineers and builders will want to refer to the section "Engineering Data and Interpretations." Tables in that section show soil characteristics that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Genesis, Classification, and Laboratory Data."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Sherman County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

* * * * *

This soil survey was made as part of the technical assistance furnished by the Soil Conservation Service to the Sherman County Soil Conservation District. Fieldwork for this survey was completed in 1959. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time.

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Issued November, 1964

SOIL SURVEY OF SHERMAN COUNTY, OREGON

BY LEO R. MAYERS

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH OREGON AGRICULTURAL EXPERIMENT STATION

SHERMAN COUNTY is in the north-central part of Oregon, bordering the Columbia River (fig. 1). The John Day River forms its eastern boundary, and the Deschutes River its western boundary. The total area is 827 square miles, or 529,280 acres.

Moro, the county seat, is near the center of the county and is 95 miles from Portland and 115 miles from Salem.

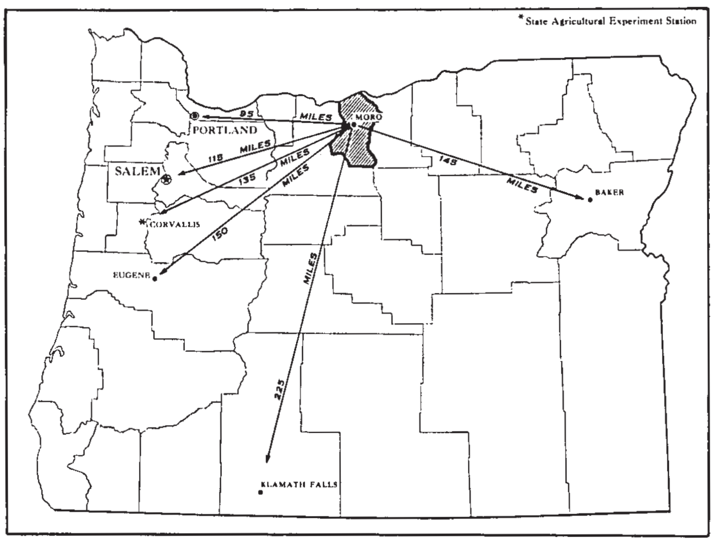

Figure 1.—**Location of Sherman County in Oregon.**

How Soils are Named, Mapped, and Classified

Soil scientists made this survey to learn the kinds of soils that are in Sherman County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report easily, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Walla Walla and Condon, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many series contain soils that differ in the texture of their surface layer. According to such differences, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Walla Walla silt loam and Walla Walla very fine sandy loam are two soil types in the series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Walla Walla silt loam, deep, 3 to 7 percent slopes, is one of several phases of Walla Walla silt loam, a soil type that has a slope range of 3 to 20 percent.

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

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. Therefore, he shows this association of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Condon-Bakeoven complex. Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on the soil map, but they are given descriptive names, such as Dune land or Riverwash, and are called land types rather than soils.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units and had shown the location of the mapping units on the soil map. He still had to present the mass of detailed information he had recorded in different ways for different groups of users, among them farmers, managers of rangelands, and engineers. To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; range sites, for those using large tracts of native grass; woodland suitability groups, for those who need to manage wooded tracts; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After study of the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. The seven soil associations in Sherman County are shown on the colored general soil map at the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic although not strictly uniform.

The soils within any one association are likely to differ in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general soil map shows, not the kind of soil at any particular place, but patterns of soils, in each of which there are several different kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soils of one soil association may also be present in other associations, but in a different pattern.

The general map is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

Figure 2.—**Typical landscape in association 1. Walla Walla very fine sandy loam encircling outcrops of basalt, near Columbia River.**

1. Walla Walla very fine sandy loam association

This association, which occupies about 4.5 percent of the county, is in the northern part along the Columbia River. It is mostly strongly rolling. The elevation ranges from about 200 feet along the Columbia River to about 1,200 feet on some of the higher ridges just 3 miles south of the river (fig. 2). Seven large V-shaped canyons cut in a general south-to-north direction through the area.

The annual precipitation averages about 13 inches, which is about 1 inch more than at the Weather Bureau station at Wasco. Moist air and fog, moving up through the Columbia Gorge, have a favorable influence on vegetation. Fairly strong westerly winds are common in spring and summer.

The Walla Walla very fine sandy loams are dominant, but the association includes significant acreages of Nansene, Starbuck, and Kuhl soils (fig. 3).

Figure 3.—**Walla Walla very fine sandy loam in foreground around typical farmstead.**

Figure 4.—**Fragments of caliche scattered on surface are common on small areas of moderately deep Walla Walla very fine sandy loam and coarse silt loam. Fragments generally are less than 12 inches in diameter.**

These soils have developed in coarse loess that was deposited over basalt, caliche, or gravel (fig. 4). Most of the soils are deep very fine sandy loams, but along the Columbia River loamy fine sands are common. The slope range is from 3 to 40 percent. Many soils are influenced by either a northerly or a southerly exposure.

The Walla Walla soils hold about 0.12 inch of available moisture per inch of depth, which is less than that held by the other cultivated soils in the county. Runoff generally is low, and water moves through the soils at a moderately rapid rate.

Nansene rocky silt loam is on very steep north-facing slopes. The largest acreage is on breaks along the Columbia River. This soil ranges from 2 to 6 feet in depth and has a thick, dark-colored surface layer. Rock slides and outcrops of basalt bedrock are numerous.

The Starbuck soils are on very steep south-facing slopes, mainly on walls of large canyons. They range from very fine sandy loam to silt loam in texture and from 1 to 2 feet in depth. The surface layer is thinner and contains less organic matter than that of either the Walla Walla or the Nansene soils. Basalt fragments of all sizes are mixed in the soil and scattered on the surface. Rock slides and outcrops of basalt bedrock are characteristic.

Some of the Kuhl soils are shallow, very rocky, and gently sloping. Others are shallow to moderately deep and very stony and occur on north-facing slopes. These soils are similar to the Walla Walla soils in color and texture.

The Walla Walla soils are used mainly for growing wheat. Yields vary greatly, however, because of the differences in soil depth and exposure. The deep north-facing Walla Walla soils produce the most; the moderately deep south-facing soils, the least. Similar soils on ridgetops and gentle slopes are intermediate in productivity, but on the deeper soils, crops respond to nitrogen fertilizer in years when moisture is adequate. Barley is grown on a large acreage because of acreage controls on wheat. During the drought of the 1930's, rye was grown on a large acreage and produced enough stubble to help control soil drifting. Now, only a very small acreage is used for rye. Some Walla Walla soils that were cultivated have been abandoned and now have a cover of cheatgrass, rabbitbrush, and sagebrush. This acreage is gradually being planted to improved perennial grasses.

Wind erosion is a serious problem on the Walla Walla soils, particularly on ridges. Stubble mulching, stripcropping, and grass-legume rotations will greatly reduce soil drifting. Water erosion occurs on steep slopes only during periods of heavy runoff.

The Nansene, Kuhl, and Starbuck soils are too steep, stony, or rocky to be cultivated. If the range is in good condition, the Nansene soil and the north-facing Kuhl soils produce abundant forage and can be used for grazing until early in summer. The Starbuck soils and the gently sloping Kuhl soils are warmer and droughtier than the Nansene soil and produce less forage. They can be used for grazing in fall and in spring. The Nansene and Starbuck soils are difficult to manage because of the long, steep and very steep slopes. Reseeding overgrazed areas is not practical.

2. Walla Walla silt loam, coarse solum, association

This association occupies about 8 percent of the county. The western part is smoothly rolling, and the eastern and southern parts are less rolling. In the western part, small drainageways run through the broad swales, and larger streams have cut into recent alluvium or basalt bedrock and formed fairly deep canyons that have steep or very steep sides.

The annual precipitation averages nearly 12 inches in the western part but is from 1 to 2 inches less in the eastern part. Westerly winds are common in spring and in summer. Wind intensity is somewhat less than in association 1, which is nearer the Columbia River.

The Walla Walla silt loams occupy more than 85 percent of the association, and the Starbuck, Bakeoven, Nansene, and Hermiston soils make up the rest. These soils have developed in slightly finer textured loess than those in association 1. Basalt and caliche are the principal underlying materials.

The depth of the soils is closely related to their location and slope. Typically, the Walla Walla soils are very deep, especially those on ridgetops and on north-facing slopes. The shallower Walla Walla silt loams occur mainly on south-facing slopes. They are fairly common in the eastern part of the association, and some of these are on gentle slopes. The range in slope is from 3 to 35 percent, but generally the slope is less than 20 percent.

The Walla Walla silt loams hold about 0.13 inch of available moisture per inch of depth. Water moves through these soils at a moderately rapid rate but at a somewhat slower rate than through the Walla Walla very fine sandy loams. The soils generally absorb most of the precipitation. Consequently, runoff is not a serious hazard.

The Starbuck soils occur only along the south-facing slopes of canyons and are of minor importance in this association. These soils have developed in shallow loess mixed with small fragments of basalt. The surface layer is thin and light colored. Most of the steep areas are very stony.

The Bakeoven soil is very shallow and very stony. It has formed from a mixture of loess and basalt. In many places, it occurs in a complex pattern with Starbuck soils.

The Nansene soil occurs on very steep north-facing

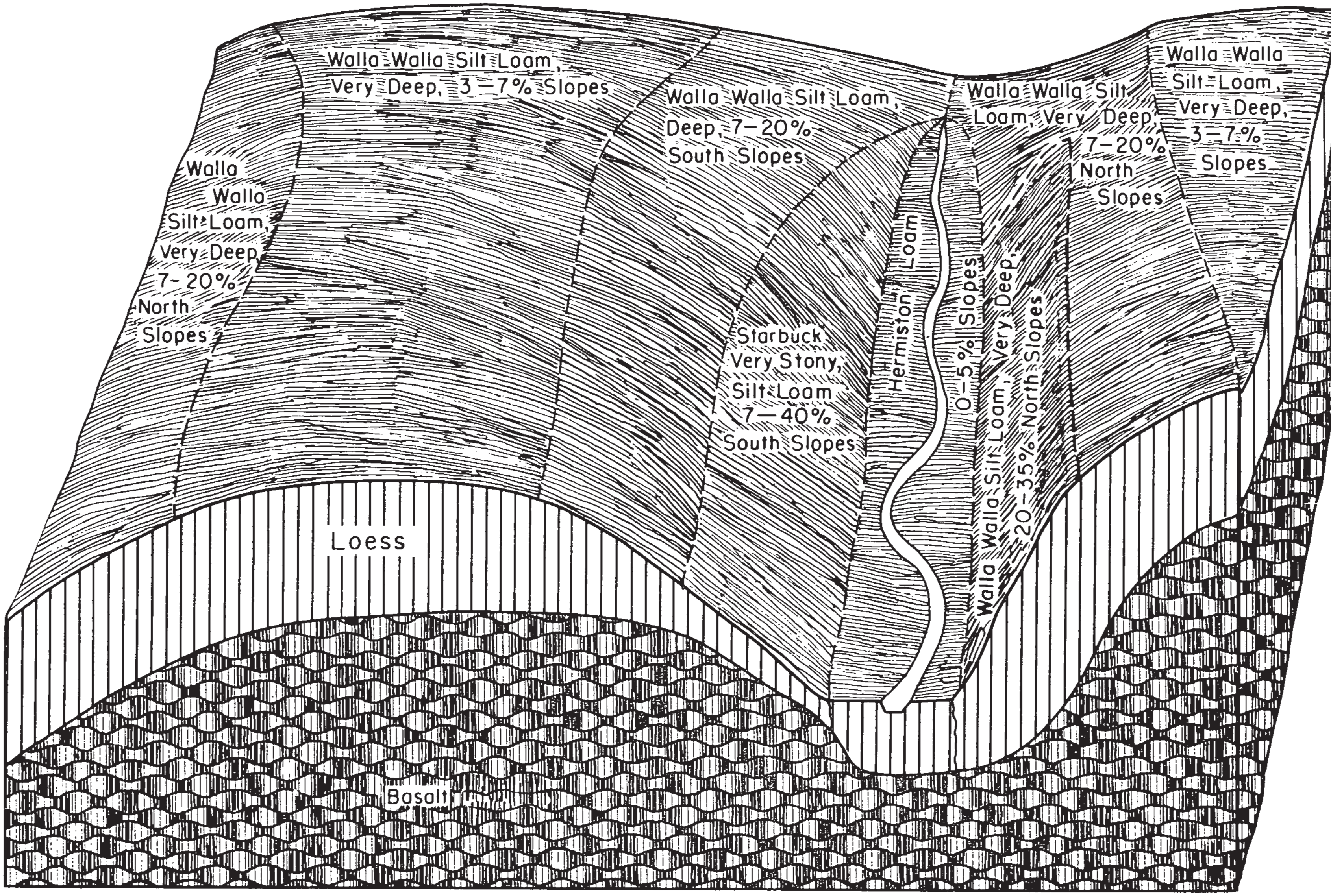

Figure 5.—**Relationship of several mapping units in association 3.**

slopes, mainly along the western, northern, and eastern edges of the association. It ranges from 2 to 6 feet in depth. The parent material is similar to that of the Walla Walla soils, but the surface layer is thicker and darker colored. Rock slides and outcrops of basalt bedrock are common. Various sized rocks are in this soil or are scattered on the surface.

The Hermiston soil occurs on the bottom of a few of the wider canyons. The largest areas are in Spanish Hollow. This soil consists of alluvium. It generally is deep and moderately alkaline.

The Walla Walla silt loams are used almost entirely for growing wheat. Yields in the western part of the association are high and vary less from year to year than on the soils in association 1. There is a gradual decrease in yields on the soils to the east. Barley is grown on many of the shallower Walla Walla soils in this association. Small areas of Walla Walla silt loams are in native grasses and are used for grazing. A few areas have been seeded to improved grasses. Most of the range is in steep, small, almost inaccessible areas that are impractical to cultivate.

The Walla Walla silt loams, particularly those on ridgetops, are susceptible to both wind and water erosion. Water erosion is a problem primarily on slopes of more than 16 percent. Stubble mulching, crosswind or cross-slope stripcropping, or grass-legume rotations, or a combination of such practices will reduce the hazard of erosion.

The Starbuck, Bakeoven, and Nansene soils are too stony, too shallow, or too steep to be cultivated. Their use is limited to grazing. The Starbuck and Bakeoven soils are low producers of forage, even if the range is in good condition. The Nansene soil produces abundant forage and, because of its northern exposure, provides later grazing than the Starbuck and Bakeoven soils.

3. Walla Walla silt loam association

This association covers about 26 percent of the county. The northwestern part, or Locust Grove section, is rolling and slopes generally to the north from Gordon Ridge. Intermittent drainageways in this section are nearly parallel, and the ridges that separate the draws are smooth and convex. South of Gordon Ridge to Nigger Ridge, the association is less sloping. The eastern part, shown on the map as 3b, is mainly gently sloping except along the large canyons.

At the Weather Bureau stations at Moro and Wasco, the annual precipitation averages about 12 inches. Late in spring, rainfall is heaviest west of Moro and Wasco. Generally, storms dissipate their moisture in an easterly direction. Westerly winds are common, but they are not so intense as the winds in associations 1 and 2.

The Walla Walla silt loams are dominant in this association (fig. 5), but soils of the Nansene, Kuhl, Hermiston, Starbuck, and Bakeoven series are also included. These soils have developed in medium-textured loess that covered the ancient basalt lava flows (fig. 6). The loessal parent material is very smooth and feels floury when dry.

In most places the Walla Walla soils extend to a depth of more than 4 feet. The shallower Walla Walla soils occur mainly on south-facing slopes but are also common on slopes near and along the deeper canyons. The range in slope generally is from 3 to 20 percent, but in a few places the slope is as much as 35 percent. Where the slope is more than 7 percent, the canyons generally run east and west and have either a northerly or southerly exposure.

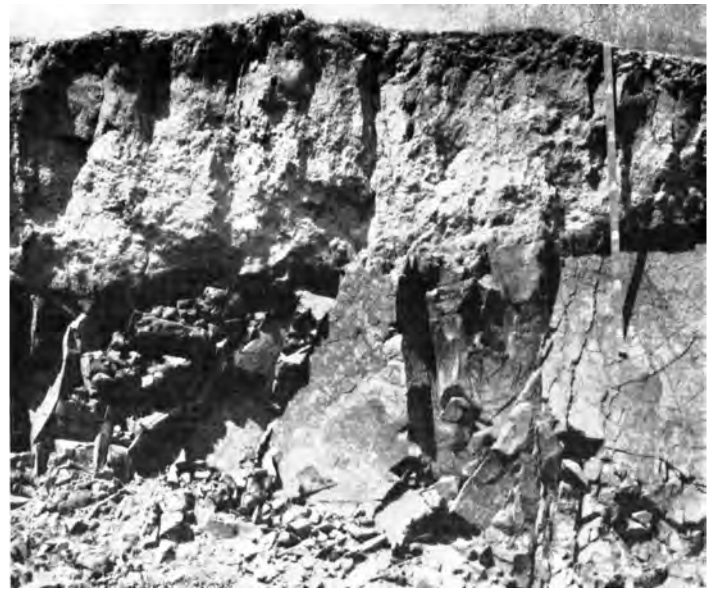

Figure 6.—**Profile of Walla Walla silt loam underlain by basalt bedrock. Soil stands in vertical bluffs and resists sloughing. This is typical of loessal soils wherever they occur in the world.**

The Walla Walla silt loams hold slightly more than 0.17 inch of available moisture per inch of depth. Surface runoff varies. In gently sloping areas, runoff is medium; in sloping areas, it is rapid; and in steep areas, very rapid. At times, heavy rains and rapid snowmelt produce considerable runoff, even on gentle slopes. Water percolates through these soils at a moderate rate but at a somewhat slower rate than through the coarser Walla Walla silt loams.

Where the Walla Walla silt loams thin out, they are joined by shallow Starbuck soils. The Starbuck soils are a shade lighter colored than the Walla Walla soils, and they extend only to a depth of 13 to 26 inches. They have developed in loess consisting of smooth silt loam and contain small fragments of basalt. The Starbuck soils occur mainly on the south-facing slopes in a complex pattern with the very stony, very shallow Bakeoven soil. Some very stony or extremely stony Starbuck soils occur alone on the south-facing slopes of the deeper canyons.

The Nansene soil is on very steep north-facing slopes along the deeper canyons. It has formed in medium-textured loess that contained an admixture of basalt. It has a thicker, darker colored surface layer than the Walla Walla soils, and it contains fragments of basalt. In places there are rock escarpments. The depth to basalt ranges from 2 to 6 feet.

The Kuhl soils are on moderately steep to steep north-facing slopes. They are stony and generally more shallow than the Walla Walla soils.

A relatively small acreage of the Hermiston soil occurs on the bottom of the Grass Valley, Hay, and Barnum Canyons. This soil consists of alluvium. Typically, it is deep and moderately alkaline.

The Walla Walla silt loams are used almost entirely for growing wheat in a summer-fallow rotation (fig. 7). In the Locust Grove section and in the vicinity of Moro, yields are very high. To the east, yields decrease. Barley is grown on some of the acreage because of the acreage controls on wheat. Grass and alfalfa have been seeded in some areas that are not well suited to wheat or barley. Native grasses grow mostly on the steeper slopes and in areas that are not accessible for cultivation.

Water erosion is the principal hazard if the Walla Walla soils are cultivated. Stubble mulching, stripcropping, and grass-legume rotations help to reduce soil losses.

The Nansene, Starbuck, Kuhl, and Bakeoven soils cannot be cultivated, because they are stony, shallow, or steep. They are used principally for range but need to be well managed to prevent overgrazing. The Nansene and Kuhl soils produce abundant forage. The Starbuck and Bakeoven soils are low forage producers. Reseeding range that is overgrazed is not practical, except on some areas of Kuhl and Starbuck soils.

4. Ritzville silt loam association

This association, which occupies slightly more than 3 percent of the county, is in the extreme east-central part. Locally, it is known as "Starvation Point." The topography is smooth to gently rolling. The Cottonwood and Grass Valley Canyons form deep gorges through the area, and their streams flow eastward to the John Day River. Generally, the area tilts toward the northeast and drains in that direction.

The annual temperature averages somewhat higher than in the association to the west. Many storms that form in the western part of the county late in spring dissipate most of their moisture before they reach this association. Consequently, the annual precipitation averages from 1 to 3 inches less than in other parts of the county. Westerly winds are common but do not affect either the soils or the crops. Hot, dry, easterly winds in June have caused crop failures.

The Ritzville silt loams are the dominant soils, but the association also includes soils of the Nansene and Starbuck series. The soils have developed in loess similar in texture to that from which the soils in association 3 were developed. The Ritzville silt loams are the only soils that are cultivated. They are lighter colored than the Walla Walla silt loams and commonly are more shallow. Their depth to basalt bedrock or calcareous material is from 30 to 50 inches. The slope range is from 2 to 35 percent, but in most places it is from 2 to 10 percent. Where the slope is more than 7 percent, the canyons generally run east and west and have either a northerly or southerly exposure.

Figure 7.—**Scene looking south from Gordon Ridge. Wheat and summer fallow on Walla Walla silt loams. Very steep north-facing canyon breaks are occupied by the Nansene soil; note cow trails and outcrops of basalt.**

The Ritzville soils hold about 0.17 inch of available moisture per inch of depth. They are moderately permeable to the underlying basalt or hard calcareous layer, but they are lower in moisture-supplying capacity than the Walla Walla silt loams because of the relatively low amount of precipitation. In most places runoff is slow to medium. Where the slope is more than 20 percent, runoff is rapid.

The Starbuck soils occur both on gentle slopes where the loessal mantle is thin and on very stony or extremely stony south-facing slopes that range from 7 to 70 percent. They also occur in a complex with the very stony, very shallow Bakeoven soil. They consist of silt loam that contains small fragments of basalt. The depth to bedrock ranges from 13 to 26 inches.

The Nansene soil is on very steep north-facing canyon breaks. It consists of silt loam that contains fragments of basalt. It has a thicker, darker colored surface layer than the Ritzville soils and ranges from 2 to 6 feet in depth to bedrock.

The Ritzville soils are used primarily for growing wheat in a summer-fallow rotation. Yields are the lowest in the county. The highest yields are obtained on the deep soils on ridges and on north-facing slopes. Because of the acreage controls on wheat, barley is grown on much of the acreage. Yields of barley are also low. Some Ritzville soils that have been abandoned for cultivated crops have been seeded to crested wheatgrass. The native range is on the steeper slopes and in areas that are not accessible for cultivation.

Water erosion is only a minor problem on the Ritzville soils. In most places soil losses can be controlled by stubble mulching. On steep slopes, stripcropping and grass-legume rotations help to stabilize the soils and to conserve moisture.

All of the Nansene soil is used for grazing or for forage plants. Yields are high. The Starbuck soils also are used for grazing, but they are somewhat droughty and are low producers of forage.

The Nansene and Starbuck soils need to be well managed to prevent overgrazing. Because of stoniness or very steep slopes, reseeding is feasible only on some of the Starbuck soils.

5. Condon silt loam association

This association, which occupies about 34 percent of the county, is south of Nigger Ridge. It generally is less rolling than the associations to the north. The extreme southern part, in the vicinity of Kent, is a nearly level plateau. Marked differences in relief occur chiefly along the deep canyons (fig. 8).

Because of the gradual rise in elevation from north to south, the southern part of this association remains cooler later in spring than the northern part. The annual precipitation ranges from about 10.5 to 12 inches. In some sections, hail and cloudbursts late in spring severely damage crops.

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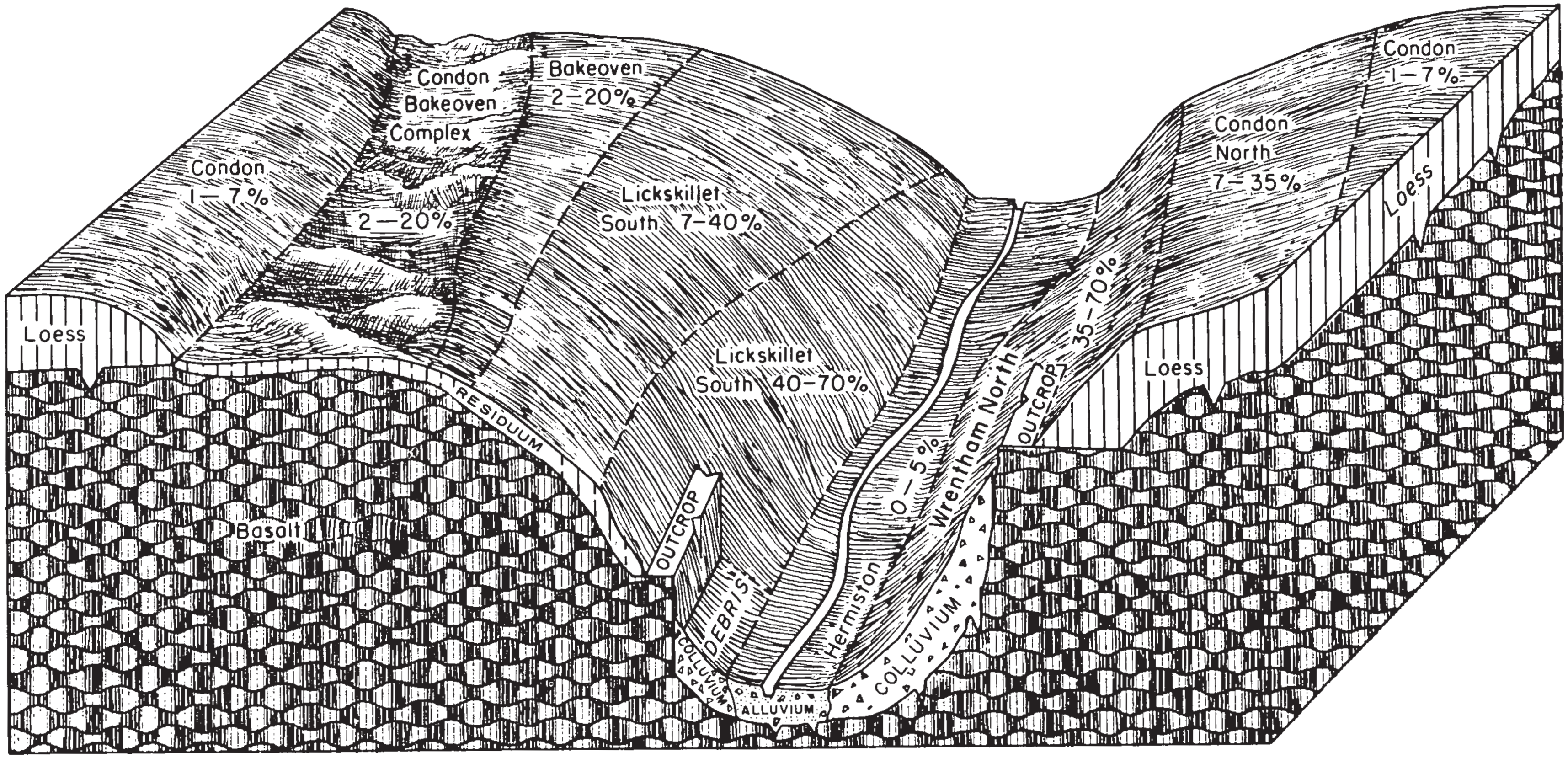

Figure 8.—**Relationship of soils to geology and physiography in soil association 5.**

Figure 9.—**Nonarable stony soil intermingled with Condon silt loam, 1 to 7 percent slopes.**

The Condon silt loams are dominant, but soils of the Bakeoven, Lickskillet, Wrentham, Hermiston, Pedigo, and Walvan series are also included. The soils in this association have developed in finer textured loess than the Walla Walla silt loams in the associations to the north. As the association extends southward from Nigger Ridge, the loessal mantle becomes thinner and finer textured. In the northern half, the depth to bedrock ranges from about 2½ to 4 feet. In the southern half, it ranges from about 1½ to 3 feet. The slope range of the largest areas of the Condon soils is from 1 to 7 percent (fig. 9).

Where the Condon soils are thinner, the Bakeoven soil occurs more commonly in the drainageways and on the edges of ridgetops. In the southern part of the association, the Bakeoven soil is scattered throughout larger areas of Condon soils to form a pattern locally called "biscuit scabland." In these areas, the Condon soils occur in large, circular or elongated mounds, or biscuits, and the Bakeoven soil occurs as scabland.

The Condon soils hold about 0.21 inch of available moisture per inch of depth. Their capacity to supply moisture to plants depends on their depth to basalt bedrock. The rate of surface runoff depends on the percentage of slope and on the condition of the surface soil, as well as on the amount and intensity of rainfall and snowmelt. In winter, runoff from fields on which winter wheat has been sown may be considerable, especially if the soil is frozen near the surface. Once water enters the soil, it percolates downward at a moderate rate. As most precipitation occurs in winter, soils that are less than 3 feet in depth to basalt bedrock are saturated or nearly saturated by spring. Consequently, tillage and harvesting are about 2 to 4 weeks later on these soils than on the Walla Walla silt loams.

The Bakeoven soil is widely distributed throughout this association, but the total acreage is much less than that of the Condon soils. This is a very shallow, very stony soil that has formed in basalt residuum and loess. It occurs both in a complex pattern with Condon soils and on the breaks from ridgetops to the canyons.

The Lickskillet soils are on south-facing canyon walls. They consist of very stony or extremely stony, shallow soils that have developed in weathered basalt and loess. The slope range is from 7 to 70 percent. The canyon breaks are characterized by lava rimrock and debris. Springs seep from the basalt bedrock.

The Wrentham soil occurs on north-facing canyon walls. This soil typically is deeper than the Lickskillet soils, and it has a thicker, darker colored surface layer. It has formed principally from loess, but in most places there are fragments of basalt mixed in the soil material.

The Hermiston soil occurs on the bottoms of many canyons, but most areas are small. This is a deep alluvial soil that typically is moderately alkaline.

The Pedigo soil is on bottom lands. This is a deep, dark-colored soil that is wet most of the time. It is of minor extent.

The Walvan soil is deep and loamy. It occupies a small acreage in the southern part of the association.

The Condon soils are used principally for growing wheat in a summer-fallow rotation. Yields are highest north and west of Grass Valley. To the south and east of Grass Valley, the yields are lower because the soils are shallower and are lower in moisture-supplying capacity. Yields of barley generally are higher on the Condon soils than on the Walla Walla and Ritzville soils in other associations. The Condon soils along the edges of this association are used mainly for range. The range that is in poor condition is suitable for reseeding with grass or alfalfa (fig. 10).

Erosion is the principal hazard if the Condon soils are cultivated. Stubble mulching, stripcropping, diversions, and grass-legume rotations help to reduce erosion and to conserve moisture.

The Wrentham, Lickskillet, and Bakeoven soils are too stony, too shallow, and too steep to cultivate. The Wrentham soil produces abundant forage but is limited in use for range because of steep slopes, rimrock, and debris. Because of their southern exposure, the Lickskillet soils are droughty and are low producers of forage. They are of limited use for range because of steep slopes, rimrock, and debris. In places, however, they are less sloping than the Wrentham soils. The Bakeoven soil is a low producer of forage. All of these soils need to be well managed if overgrazing is to be prevented.

The Hermiston soil is used chiefly for grazing, but most of the range is in poor condition. The Walvan soil is used primarily for growing wheat. It is slightly coarser textured than the Condon soils and is susceptible to both wind and water erosion.

Figure 10.—**Fence separates range in good condition from range in poor condition on Condon silt loam.**

Figure 11.—View of Deschutes River gorge from Gordon Ridge Road. At this point, the depth of the canyon is about 1,200 feet. Mount Hood is on the horizon. Soils on these very steep slopes are the Lickskillet, Nansene, and Starbuck. Outcrops of basalt and rock slides are common.

Figure 12.—On the left is Starbuck extremely stony silt loam, on very steep south-facing slopes; on the right is Nansene rocky silt loam, on very steep north-facing slopes. Note prominent cow trails on the Nansene soil.

6. Nansene rocky silt loam-Starbuck extremely stony silt loam-Lickskillet extremely stony loam association

This association, which occupies slightly more than 8 percent of the county, is characterized by river breaks and very steep canyons (fig. 11). It occurs in narrow strips along the Deschutes River, from Nigger Ridge to the Columbia River, and along the John Day River, from just north of Ferry Canyon to the Columbia River. The soils have developed in loess and basalt residuum.

The annual precipitation is about 12 inches along the Deschutes River and about 9 to 11 inches along the John Day River. Soils that are on south-facing slopes and on bottom lands along the rivers are warmer and droughtier than those on north-facing slopes.

The Nansene, Starbuck, and Lickskillet soils are dominant, but the association also includes soils of the Sagemoor, Hermiston, Walla Walla, and Ritzville series, and Sandy alluvial land.

The Nansene soil is on very steep north-facing slopes and is high in moisture-supplying capacity. It has a thick, dark-colored surface layer and generally is silt loam throughout the profile. The parent material consists chiefly of loess, but fragments of basalt have rolled from the rimrock and the escarpments and are mixed in much of the soil material. The depth to basalt ranges from 2 to 6 feet. Springs are more common along the Deschutes River than along the John Day River.

The Starbuck soils are on most of the south-facing slopes, mainly along the John Day River. These soils have developed principally from loess, but fragments of basalt are mixed in the soil material. They range from silt loam to very fine sandy loam in texture and from 13 to 26 inches in depth to basalt bedrock. In most places they are extremely stony and shallow and are lighter colored than the Nansene soil (fig. 12). Because of shallowness and the influence of a southerly exposure, they are low in moisture-suppling capacity.

The Lickskillet soils occur mainly on south-facing slopes along the Deschutes River. They have a more clayey subsoil than the Starbuck soils and have developed in both basalt residuum and loess. They are shallow and are very stony or extremely stony. The depth to basalt bedrock ranges from 12 to 24 inches. Because of shallowness and the influence of a southerly exposure, these soils are low in moisture-supplying capacity.

The Sagemoor soil is on terraces along both the Deschutes and John Day Rivers. It occurs opposite the main cutting bank of the rivers, at elevations of less than 1,000 feet.

The Hermiston soil and Sandy alluvial land occur mainly along the John Day River, but there are a few areas along the Deschutes River (fig. 13). They consist of recent alluvium. The Hermiston soil is mostly loam. Sandy alluvial land varies in texture but is mostly fine sandy loam.

Figure 13.—Sandy alluvial land on canyon floor. Lickskillet extremely stony loam on south-facing slope in foreground. Walla Walla silt loam, low rainfall, on less sloping ridges. Nansene rocky silt loam on very steep north-facing slope.

Most of the acreage in this association is used for range. Only a few small areas of the Hermiston, Walla Walla, and Ritzville soils and Sandy alluvial land are cultivated.

The Nansene soil is the highest producer of forage in this association and can be grazed until midsummer. The grasses mature later on this soil than on soils that have a southern exposure.

The Lickskillet and Starbuck soils are low producers of forage. In summer, the south-facing slopes are hot and forage plants are dormant. Grazing is best late in winter and in spring.

The Nansene, Starbuck, and Lickskillet soils need to be well managed to prevent overgrazing. Their use for grazing is limited, however, by the lack of water for stock and by the steep slopes and natural barriers of rimrock and debris.

The range on the Sagemoor soil is in poor condition. In moist years annual grasses provide some forage, but in dry years yields are low.

The range on the Hermiston soil and Sandy alluvial land is also in poor condition. In a few areas, the soils have been cleared of sagebrush and have been leveled and irrigated for pasture and hay plants.

It is not practical to reseed any of the soils that are used for range, except those on bottom lands that are irrigated.

7. Wrentham rocky silt loam-Lickskillet extremely stony loam association

This association, which occupies almost 16 percent of the county, occurs both in a narrow strip along the Deschutes River, south of Nigger Ridge to the county line, and in a narrow strip along the John Day River, from just north of Ferry Canyon southward to the county line. It is characterized by many deep V-shaped canyons. The elevation ranges from about 700 to 2,800 feet.

The annual precipitation is ordinarily 10 to 12 inches. There is a considerable difference in temperature and in effective moisture on southerly and northerly exposures. South-facing slopes are warmer and droughtier.

The Wrentham and Lickskillet soils are dominant, but the association also includes soils of the Bakeoven, Condon, Sagemoor, and Hermiston series, Sandy alluvial land, and Rock outcrop and rubble land (fig. 14). The soils have developed mainly in loess and basalt residuum.

The Wrentham soil occurs on very steep north-facing slopes and ranges from 18 inches to more than 60 inches in depth to basalt. This soil has a thick, dark-colored surface layer of silt loam and a lighter colored subsoil of silty clay loam or heavy silt loam. In many places ancient basalt lava flows are exposed, and escarpments and debris are common. Fragments are mixed in the soil material, and rocks and stones are scattered on the surface.

The Lickskillet soils occur on steep and very steep south-facing slopes (fig. 15). These are very stony, shallow soils that range from 12 to 24 inches in depth to basalt bedrock. The surface layer is thinner and contains less organic matter than that of the Wrentham soil. The subsoil varies in texture but typically is clay loam or heavy loam. Debris and outcrops of basalt are common.

The Bakeoven and Condon soils occur in inextensive areas on narrow ridgetops between the Wrentham and Lickskillet soils. The Bakeoven soil is very shallow and very stony. Locally, it is called scabland. The Condon soils are mostly moderately deep. They occur mainly on ridges but are also on moderately steep north-facing slopes.

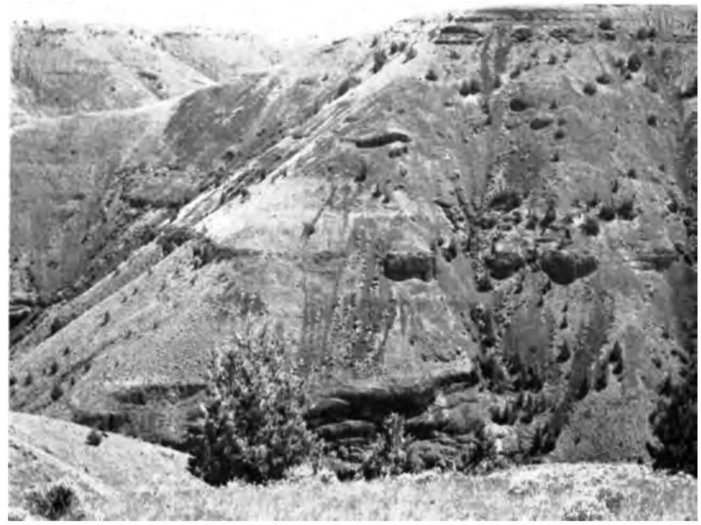

Figure 14.—**Rock outcrop and rubble land, joined on left by Wrentham rocky silt loam, 35 to 70 percent slopes.**

The Sagemoor soil occurs opposite the main cutting banks of the John Day and Deschutes Rivers, at elevations below 1,000 feet. It is calcareous, light-colored silt loam.

The Hermiston soil and Sandy alluvial land are on bottoms, mainly along the John Day River. In most places the Hermiston soil is a deep loam. Sandy alluvial land is also deep, but typically it is fine sandy loam.

Most of the acreage in this association is used for grazing. The north-facing Wrentham soil is the highest producer of forage and, if well managed, can be used for grazing until midsummer.

Forage yields are low on the Lickskillet soils, even if the range is in good condition. During the summer, the south-facing slopes are hot and the forage plants are dormant. The best seasons for grazing are spring, fall, and the last part of winter.

Figure 15.—**(*A*) Lickskillet extremely stony loam, 40 to 70 percent south slopes; (*B*) Rock outcrop and rubble land; and (*C*) Wrentham rocky silt loam, 35 to 70 percent slopes.**

Both the Wrentham and Lickskillet soils are of limited use for range, however, because of steep slopes, natural rock barriers, and inadequate and poorly distributed water for livestock.

The Condon soils produce a moderate amount of forage if the range is in good condition.

On the Sagemoor and Hermiston soils and on Sandy alluvial land, most of the range is in poor condition. Cheatgrass is the only forage plant on these soils. It matures early and varies widely in yields from year to year. The larger accessible areas of the Hermiston soil and Sandy alluvial land are suitable for irrigation.

Use, Management, and Productivity of the Soils

This section has six main parts. The first part is a general discussion of management of the cropland; the second groups the soils in capability units and explains the capability classification used by the Soil Conservation Service to show the relative suitability of the soils for various uses; the third discusses hay and pasture seedings; the fourth consists mainly of a table giving estimated yields for dry-farmed wheat and a table showing the levels of management required to obtain these yields; the fifth discusses range management and groups the soils used for range in range sites; the sixth consists of engineering data and interpretations.

Management of Soils for Crops [1]

Under the grain-fallow system of farming in Sherman County, the major management needs are conservation of moisture, control of erosion, preservation of soil structure and tilth, maintenance of the organic-matter content and the supply of plant nutrients, proper tillage, management of residues, a suitable cropping system, and wise use of commercial fertilizers and other amendments.

Management needs

Different soils require different treatments, and the same soil may require variations in treatment from year to year or from crop to crop. Following is a discussion of the basic management needs.

Conserving moisture.—Most cultivated soils in Sherman County are limited in productivity because of inadequate moisture. It is important, therefore, to conserve and use efficiently all the moisture that is available. During the fallow season, evaporation losses can be kept to a minimum by maintaining a surface mulch and tilling only enough to control weeds.

Controlling erosion.—Many of the soils in Sherman County are shallow or moderately deep. In most soils, the surface layer is no more than 18 inches thick. Further erosion will reduce the ability of the soils to store moisture and supply nutrients. Continued erosion, particularly of some of the shallower soils, will so reduce their productivity that in time they will be suitable only for range or pasture. Proper tillage, the maintenance of organic matter, and the preservation of soil structure will help to control erosion.

Preserving soil structure.—Proper tillage and the maintenance of the organic-matter content are the two principal factors in building and preserving good soil structure.

Excessive tillage while the soil is fallow tends to destroy organic matter and to destroy the soil aggregates. This reduces the permeability of the soil to water, air, and roots.

Maintaining organic matter.—Organic matter is the partially rotted remains of plants and soil organisms. The organic-matter content of the soils of Sherman County varies from a high of 3 or 4 percent under native plant cover to a low of 1 or 2 percent after a long period of cultivation.

Organic matter binds soil particles together in aggregates and thus helps to preserve soil structure. It is the source of most of the nitrogen in the soil and also supplies other plant nutrients, such as phosphorus and sulfur. The process of rotting, or decomposition, is actually the feeding of soil organisms. This releases nutrients in a form available to plants.

The organic matter in the soil is constantly decomposing. Therefore, the supply must be renewed regularly and often. An adequate supply can be maintained by the following practices:

1. Returning all crop residues to the soil. Crop residues are the main source of organic matter. The organic matter is lost if residues are burned or otherwise destroyed.
2. Spreading barnyard manure on the field. In areas where wheat is grown, the supply of manure is limited and its use is restricted to slick spots or hardpan areas.
3. Using commercial fertilizers to produce larger yields and greater amounts of residues and to supply nitrogen to the soil organisms. The rate of turnover of organic matter is often limited by lack of adequate nutrients for the bacteria.
4. Growing grass and legumes in a rotation, to provide a readily usable supply of organic material that decomposes rapidly and speeds the release of plant nutrients.

Supplying plant nutrients.—The soils of Sherman County are now adequately supplied with all of the essential plant nutrients except nitrogen and, in a few places, sulfur. It may be possible to stimulate a temporary release of these nutrients through management, but eventually they will have to be supplied by the application of commercial fertilizer.

Cropping systems

A cropping system may be a regular rotation of different crops, in which the crops follow each other in a definite order, or it may consist of only one crop grown year after year. The number and variety of cropping systems in Sherman County are limited by the low precipitation and the shortage of underground wells or accessible surface water. The principal cropping system is grain and fallow. Other dryland cropping systems are (1) the annual cropping of grain for seed or hay; (2) grass or grass and

[1] H. C. GRABENHORST, Soil Conservation Service; W. E. HALL, superintendent, Moro Experiment Station; H. E. CUSHMAN, Extension Service, Oregon State University; and THOMAS W. THOMPSON, county extension agent, assisted in the preparation of this section.

alfalfa with grain; (3) irrigated orchards and grass and legumes for hay and pasture.

Fallow cropping system.—Most of the nearly 300,000 acres of cropland in Sherman County is used for summer-fallow farming. In summer-fallow dryland farming, the soil is kept free of vegetation during one crop season in order to store additional moisture for the growth of a crop the following season. This practice also helps to control weeds and speeds the release of plant nutrients through the activity of soil micro-organisms.

The most common method of fallowing is to permit the stubble from a crop to stand during the winter. The soil is tilled in March or April, before the weeds have removed much of the moisture and before the surface becomes too dry. Tillage is also performed during the summer to keep the soil free of weeds and to prepare a seedbed for fall planting. If spring crops are grown, the soil is left rough through the winter.

The grain-fallow cropping system has increased grain yields and has tended to stabilize production. Complete crop failures are few. Weeds, plant diseases, and insects can be controlled more effectively if the soil is fallowed periodically. However, erosion by wind and water is more likely under the grain-fallow system than under continuous cropping.

The summer-fallow cropping system was adopted in Sherman County before the turn of the century. Only about a third of the precipitation that occurs during a 2-year period is utilized by crops. Water losses through evaporation from fallow soils are high, however, and in certain years runoff is rapid because of slow infiltration on finely tilled seedbeds or frozen ground. These problems have caused farmers and research workers to look for other cropping systems.

Annual cropping of grain.—Less than 1,000 acres of cropland is used for annual dry-farmed grain. Current weed-control and fertilizer applications decrease the relative advantage of summer-fallow. Research work indicates a probable increase in the use of this system on some soils. On shallow soils that are filled with moisture each year, summer-fallow need not be practiced. Removal of acreage controls and additional research on methods of tillage and fertilization may allow greater use of this system.

Grass-legume rotation.—A limited acreage in Sherman County is utilized for a rotation of grass and legumes with grain and fallow. This rotation is used to improve fertility, increase the rate of water infiltration, and reduce soil erosion. Acreage controls and price programs have interfered to some extent with this cropping system.

Grasses and legumes can be used for rotation hay or pasture. Grasses and legumes seeded on summer-fallow or in spring of the stubble year generally can be used for forage the second year.

Plowing up the grass-legume sod and rotating to other fields should be done at about the time of maximum root growth. Experiments at the Sherman Branch Experiment Station show maximum root growth of adapted species in about 4 years. Soils used for grass-legume rotations are plowed in 4 or 5 years and seeded to grain again.

A successful grass-legume seeding depends on a firm seedbed and on a seed mixture that is readily established. The success of the rotation depends on fitting the rotation in with other rotations on the rest of the farm. Grass-legume varieties and seeding rates are given in the subsection "Hay and Pasture Seedings." Recommendations for fertilizers and seed treatment can be obtained from the county agricultural extension agent.

Irrigated cropping systems.—The sandy soils adjacent to the Columbia River are well suited to fruit orchards. The low elevation provides a moderate climate for the growth of peaches, apricots, and cherries. Irrigation water from springs, wells, and the Columbia River is abundant.

Normally, a winter cover crop is grown in orchards, to control wind and water erosion. The cover crop generally is seeded in August or September. Nitrogen is applied to give the cover crop a quick start. Suitable cover crops are barley, wheat, or rye grown with a legume, such as hairy vetch, common vetch, or peas. The cover crop is disked in spring to conserve moisture, and enough residue is left on the surface to control wind erosion.

The acreage in irrigated hay and pasture has tripled during the past 10 years, but these crops are still of minor importance. Irrigated forage is grown along the bottom lands adjacent to streams or where wells or irrigation dams have been constructed.

Alfalfa is the principal legume grown for hay. It is grown alone or in combination with suitable grasses. Yields are good throughout a wide range of conditions. Seed mixtures for hay or pasture are given in the subsection "Hay and Pasture Seedings."

Good stands, adequate irrigation and fertilization, and controlled grazing are essential for high yields of pasture crops and hay. Sulfur is needed annually on alfalfa. Soil tests should be made to determine the need for phosphorus and boron. Grass pastures require moderately large amounts of nitrogen each year.

Management of grazing is essential for high yields but should be flexible so that all the forage is used for pasture or hay. Good management increases yields, reduces selective grazing, cuts forage waste, and controls the quality of the forage. Pastures can be divided, and grazing rotated every 3 or 4 weeks.

Stubble mulching

Stubble mulching is the management of crop residues on a year-round basis so as to keep a protective cover on the surface of the soil between crops. It is the primary conservation practice in grain-fallow farming in Sherman County. If stubble mulching alone is not adequate, other protective measures should be applied.

After harvest and during winter months, tillage is necessary to control weeds and volunteer grain. If a moldboard plow is used, this can be accomplished in one operation, but the soil is left without a protective cover. Stubble mulching may require two or three operations, but it leaves the crop residues on the surface.

Chisels and sweeps are the implements used in stubble mulching. Chisels fracture the soil; sweeps cut below the surface. Seldom does the first operation kill all of the winter growth. Chisels may have to be used twice, and in some cases both chisels and sweeps must be used.

Stubble-mulch tillage should be shallow, because shallow tillage is more effective in killing weeds and also provides a firm base for the first use of the rod weeder.

The use of offset rotary hoes, or skew treaders, shortly after the sweeps or chisels, is also effective in killing weeds. In this operation, the soil is shaken from the roots, and the cheatgrass sod is broken and shaken out. At the same time, excessive stubble is scattered, shredded, and broken in preparation for the rod weeders. Excessive use of the offset rotary hoes, however, will pulverize the soil and destroy the stubble. Where the stubble is thick enough to interfere with rod weeding, the rotary hoe can be used to shred the stubble without fear of destroying clods. Sufficient mulch will remain to protect the soil.

Rod weeding should be as shallow as possible, but deep enough to avoid skips and to get below any partially buried straw. Center-drive rod weeders that have high clearance help to lessen the problems of stubble-mulch tillage.

Delaying stubble-mulch tillage until spring rains are less likely and the surface soil is drier helps to control weeds. The use of chemicals to destroy the winter growth and thereby allow delayed tillage appears promising.

The number of fallow operations depends on the frequency and amount of rain that starts new weed growth. Stubble mulching keeps weed seeds near the surface, and the moisture under the mulch keeps the seeds germinating.

For preparing seedbeds in stubble-mulch fallow, wide-spaced drills that allow the stubble to pass through are best. They have greater seeding depth; consequently, a fine-tilled, level seedbed is not necessary. Moisture remains closer to the surface under stubble mulch, and the probability of seeding in moist soil is greater.

Seeding with a deep-furrow drill can cause serious erosion if excess water is allowed to accumulate in the furrows. Grassed waterways, contour strips, or other conservation practices may be necessary. Early seeding will provide a cover of vegetation to help control erosion in the furrows.

Deep furrow ridges can be eliminated in spring of the crop year by the use of offset rotary hoes. The leveling of these furrows will reduce wear on machinery during harvest and when weeds are sprayed.

If, at the time of harvest, next year's tillage is considered, many of the problems of stubble mulching can be eliminated. Straw should be evenly distributed over the soil surface instead of being dropped in straw rows; the largest amount of straw that can be handled without decreasing the efficiency of threshing should be taken into the machine to lessen the need for breaking stubble later; and excess straw should be bunched in the straw dumps to provide bedding for livestock.

Soil erosion

About 95 percent of Sherman County is subject to accelerated erosion caused by the disturbance of natural conditions through burning, excessive grazing, or tillage. Loss of soil can result from either blowing or water erosion.

Soil blowing can be a major problem on about 14 percent of Sherman County. The soils most likely to be affected are the Walla Walla very fine sandy loams and the Walla Walla silt loams that have a coarse solum. During years when moisture is favorable, crop residues, if properly managed, are sufficient protection for these soils. During prolonged droughts, conservation practices, such as stubble mulching, crosswind tillage, stripcropping, and minimum tillage, may be necessary to prevent soil blowing. Wind erosion is also a hazard on the coarse-textured soils on the range adjacent to the Columbia River; on the alluvial soils adjacent to the three major rivers; on soils on the bottom lands along small creeks or drainageways; and on small pockets of the Walvan soils that are scattered throughout the southern half of the county.

Normally, water erosion is a less serious hazard on the dry cultivated soils in Sherman County than blowing, because much of the precipitation comes in the form of gentle rain. Occasionally, however, localized rain or hailstorms of high intensity, rain of long duration, rain on frozen ground, or rapid snowmelt cause considerable runoff, and soil losses on unprotected soils are then high.

Soil losses from rill erosion have been studied in the county, and measurements have been taken to evaluate soil losses on some cultivated fields following periods of severe runoff. Table 1 shows the maximum loss of soil from rill erosion, in tons per acre, in fields protected with stubble mulch and in fields in black fallow.

TABLE 1.—*Maximum tons of soil loss per acre from rill erosion*

Soil	Slope	Acres evaluated	Soil loss	
			Black fallow	Stubble mulch
			Tons per acre	*Tons per acre*
Walla Walla silt loam.	Less than 7 percent.	34, 108	17	Not measurable.
	7 to 20 percent.	28, 272	107	Less than 5.
	20 to 35 percent.	1, 822	133	27.
Walla Walla silt loam, low rainfall.	Less than 7 percent.	38, 460	9	Not measurable.
	7 to 20 percent.	19, 640	32	Less than 5.
	20 to 35 percent.	1, 368	56	11.
Condon silt loam.	Less than 7 percent.	98, 923	20	Not measurable.
	7 to 20 percent.	30, 433	101	3 to 4.
	20 to 35 percent.	3, 284	135	23.
Walla Walla silt loam, coarse solum.	Less than 7 percent.	24, 247	9	Not measurable.
	7 to 20 percent.	15, 832	15	Not measurable.
	20 to 35 percent.	5, 300	45	7.

The runoff studies conducted within the county demonstrate the value of applied practices for control of erosion. Generally, no single practice will give satisfactory results. A combination of practices commonly is required.

About 26,500 acres of Sherman County is subject only to geologic, or normal, erosion. This acreage is made up of areas of basalt outcrop, rock land, and riverwash. These areas are so steep, so rocky, or so exposed that any soil that forms is soon washed or blown away. Deposits, such as sand and gravel bars, along the Deschutes, Columbia, and John Day Rivers move too often to support much vegetation.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels—the capability class, the subclass, and the unit. The eight capability classes are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, grazing, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere 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 country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are subject to little or no erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIc–1 or IIIe–2.

Soils are classified in capability classes, subclasses, and units according to the degree and kind of permanent limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in Sherman County, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use. (There are no class I soils in Sherman County.)

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

- Subclass IIc. Soils that have moderate limitations because of climate.
  - Unit IIc–1. Deep and very deep, gently sloping silt loams.
- Subclass IIw. Soils that have moderate limitations because of excess water.
  - Unit IIw–1. Deep, nearly level, imperfectly drained soils.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
  - Unit IIIe–1. Deep and very deep, moderately steep and steep silt loams on north-facing slopes.
  - Unit IIIe–2. Deep and very deep, moderately steep silt loams on south-facing slopes.
  - Unit IIIe–3. Moderately steep, moderately deep and deep silt loams on north-facing slopes, and moderately steep, deep silt loams on south-facing slopes.
  - Unit IIIe–4. Very deep, gently sloping coarse silt loams, and deep very fine sandy loams on north-facing slopes.
  - Unit IIIe–5. Deep and very deep, moderately steep to steep coarse silt loams on north-facing and south-facing slopes.
  - Unit IIIe–6. Moderately deep and deep coarse silt loams on moderately steep slopes.
- Subclass IIIs. Soils that have very severe limitations of moisture capacity, depth, or alkalinity.
  - Unit IIIs–1. Moderately deep, gently sloping silt loams.
  - Unit IIIs–2. Deep, nearly level, mildly to strongly alkaline alluvial soils.
- Subclass IIIc. Soils that have severe limitations because of climate.
  - Unit IIIc–1. Deep and very deep, gently sloping coarse silt loams, very fine sandy loams, and ashy soils.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVe. Soils subject to severe erosion if they are cultivated and not protected.
  - Unit IVe–1. Moderately deep, steep silt loams on north-facing slopes.
  - Unit IVe–2. Moderately deep, moderately steep silt loams on south-facing slopes.
  - Unit IVe–3. Very deep and deep, steep coarse silt loams on south-facing slopes.
  - Unit IVe–4. Moderately deep, moderately steep and steep coarse silt loams on south-facing slopes.
  - Unit IVe–5. Moderately deep, gently sloping to steeply sloping very fine sandy loams.
  - Unit IVe–6. Moderately deep, gently sloping and moderately steep silt loams on south-facing slopes.
  - Unit IVe–7. Moderately deep and deep, gently sloping to steeply sloping very fine sandy loams, coarse silt loams, and silt loams.

Subclass IVw. Soils that have very severe limitations because of excess water.

Unit IVw–1. Very deep, nearly level, poorly drained soils.

Class V. Soils subject to little or no erosion that have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover. (There are no class V soils in Sherman County.)

Class VI. Soils that have severe limitations that make them unsuitable for cultivated crops and limit their use to pasture, range, or wildlife food and cover.

Subclass VIe. Soils severely limited by hazard of erosion.

Unit VIe–1. Sandy, sloping, or shallow soils.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivated crops and that restrict their use to grazing or wildlife.

Subclass VIIe. Soils very severely limited by risk of erosion.

Unit VIIe–1. Coarse-textured soils.

Subclass VIIs. Soils with very severe soil and slope limitations.

Unit VIIs–1. Sloping, stony, or rocky soils.

Class VIII. Land types not suited to commercial plant production.

Subclass VIIIe. Land types subject to severe wind blowing.

Unit VIIIe–1. Dune land.

Subclass VIIIs. Land types unsuitable for crops, pasture, hay, or range.

Unit VIIIs–1. Land types consisting mainly of coarse fragments.

In the following pages the soils in each capability unit are listed and management for each unit is suggested.

Capability unit IIc–1

Deep and very deep, gently sloping silt loams

These soils occur on extensive ridgetops in the central and northern parts of the county. Drainage is good, and permeability is moderate. Slopes are gentle, and runoff is slow. Water erosion is a slight hazard. The moisture-supplying capacity is high to very high, fertility is high, and workability is very good. The soils in this unit are—

- Condon silt loam, deep, 1 to 7 percent slopes.
- Walla Walla silt loam, very deep, 3 to 7 percent slopes.
- Walla Walla silt loam, deep, 3 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, deep, 3 to 7 percent slopes.

Use, suitability, and management.—These soils are well suited to wheat and moderately well suited to barley. Yields of alfalfa and perennial grasses for hay or pasture are sufficient to make these crops suitable for inclusion in a long rotation.

Stubble-mulch tillage will slow surface runoff, increase the rate of water intake, and help to control erosion. Cross-slope cultivation, stripcropping, or other conservation practices may be needed on long slopes. Shaped, permanently sodded natural drainageways will remove excess runoff safely. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIw–1

Deep, nearly level, imperfectly drained soils

This unit consists of Clayey basin land. This land type occurs in a nearly level depression that formerly was the bottom of a lake. Drainage is imperfect, and permeability is slow. Runoff is ponded, and water erosion is not a hazard. The moisture-supplying capacity is very high, fertility is moderate, and workability is fair.

Use, suitability, and management.—This land type is well suited to wheat, moderately well suited to barley, and moderately well suited to alfalfa and perennial grasses for hay and pasture.

Wetness in the spring delays tillage. Rough tillage in fall will help dry and warm the soil. Rough tillage and the use of crop residues and other mulching materials will improve workability. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIe–1

Deep and very deep, moderately steep and steep silt loams on north-facing slopes

These soils are similar to the soils described in unit IIc–1, except that they are on moderately steep and steep north-facing slopes. Runoff is rapid, and the hazard of water erosion is moderate to severe. The moisture-supplying capacity is high to very high, depending on the depth of the soil. Fertility is high, and workability is good to poor. The soils in this unit are—

- Condon silt loam, deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, very deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, very deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, low rainfall, very deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, low rainfall, very deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, low rainfall, deep, 7 to 20 percent north slopes.

Use, suitability, and management.—These soils are well suited to wheat and moderately well suited to barley. Because of the influence of a northern exposure, crops mature later and yields generally are higher on these soils than on similar soils that have a southern exposure. Yields of alfalfa and perennial grasses for hay or pasture are sufficient to make these crops suitable for inclusion in a long rotation.

Stubble-mulch tillage will slow surface runoff, increase the rate of water intake, and help to control erosion. On long slopes that have a gradient of 7 to 20 percent and on all slopes that have a gradient of more than 20 percent, additional conservation practices that include cross-slope or contour farming, stripcropping, and diversion terraces generally are needed for control of erosion. Hay and pasture plants should be grown in rotation on soils that have slopes of 20 to 35 percent. Shaped, permanently sodded natural drainageways will safely remove excess runoff. Small grain generally responds to nitrogen fertilizer.

Means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIe-2

Deep and very deep, moderately steep silt loams on south-facing slopes

Except for stronger slopes and a southern exposure, these soils are similar to those in unit IIc-1. Runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is good, fertility is high, and workability is good. The soils in this unit are—

- Walla Walla silt loam, very deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, deep, 7 to 20 percent south slopes.

Use, suitability, and management.—These soils are moderately well suited to wheat, fairly well suited to barley, and fairly well suited to alfalfa and perennial grasses for hay and pasture. Because of the influence of a southern exposure, crops mature earlier and yields are lower on these soils than on similar soils that have a northern exposure.

Stubble-mulch tillage will slow runoff, increase the rate of water intake, and help to control erosion. Cross-slope cultivation, stripcropping, or other conservation practices may be needed on long slopes. Shaped, permanently sodded natural drainageways will safely remove excess runoff. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIe-3

Moderately steep, moderately deep and deep silt loams on north-facing slopes, and moderately steep, deep silt loams on south-facing slopes

These soils have good moisture-supplying capacity and are easily worked. Runoff is medium to rapid, and the hazard of water erosion is slight to moderate. The soils in this unit are—

- Condon silt loam, 7 to 20 percent north slopes.
- Ritzville silt loam, 7 to 20 percent north slopes.
- Walla Walla silt loam, moderately deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, low rainfall, deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent north slopes.

Use, suitability, and management.—All of these soils are moderately well suited to both wheat and barley except the Ritzville soil, which is only fairly well suited to barley. All are moderately well suited to alfalfa and perennial grasses for hay or pasture. Crops mature later on the north-facing slopes than on the south-facing slopes.

Stubble-mulch tillage will slow surface runoff, increase the rate of water intake, and help to control erosion. On long slopes, cross-slope cultivation, stripcropping, field diversions, or other conservation practices may be needed. Grassed waterways will safely remove excess runoff. Nitrogen fertilizer will increase grain yields only if rainfall is higher than normal during the crop year.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIe-4

Very deep, gently sloping coarse silt loams, and deep very fine sandy loams on north-facing slopes

These soils are fertile, are easily worked, and are high in moisture-supplying capacity. Runoff is slow to medium, and the hazard of wind erosion is slight to moderate. The soils in this unit are—

- Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes.
- Walla Walla very fine sandy loam, deep, 7 to 20 percent north slopes.
- Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes.

Use, suitability, and management.—These soils are moderately well suited to well suited to wheat but only fairly well suited to spring barley. Yields of alfalfa and perennial grasses for hay or pasture are sufficient to make these crops suitable for inclusion in a long rotation.

Stubble-mulch tillage will slow surface runoff, reduce evaporation, increase the rate of water intake, and help to control erosion. Crosswind farming, stripcropping, or field windbreaks may be needed on short slopes in critical soil areas. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIe-5

Deep and very deep, moderately steep to steep coarse silt loams on north-facing and south-facing slopes

These soils occur in the northern part of the county. Drainage is good, and permeability is moderately rapid. Runoff is medium to rapid, and the hazard of erosion is moderate to severe. The moisture-supplying capacity is good to high, depending on the depth of the soil and the exposure. Fertility is high, and workability is good to poor. The soils in this unit are—

- Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent north slopes.

Use, suitability, and management.—These soils are well suited to moderately well suited to wheat, but they are only fairly well suited to barley. Yields of alfalfa and perennial grasses for hay or pasture are sufficient to make these crops suitable for inclusion in a long rotation.

Stubble-mulch tillage will slow surface runoff, reduce evaporation, increase the rate of water intake, and help to control both wind and water erosion. On long slopes that have a gradient of 7 to 20 percent and on all slopes that have a gradient of 20 to 35 percent, crosswind tillage, wind-water tillage, or wind-water stripcropping is also needed. Hay and pasture plants should be grown in a rotation on the soils that have slopes of 20 to 35 percent. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIe-6

Moderately deep and deep coarse silt loams on moderately steep slopes

These soils occur in the northern part of the county. Drainage is good, and permeability is moderately rapid. Runoff is medium, and the hazard of water and wind erosion is moderate. The moisture-supplying capacity is low to good, fertility is moderate to high, and workability is good to fair. The soils in this unit are—

- Walla Walla silt loam, coarse solum, deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent north slopes.

Use, suitability, and management.—These soils are moderately well suited to wheat, only fairly well suited to barley, and moderately well suited to alfalfa and perennial grasses for hay and pasture.

Stubble-mulch tillage will slow runoff, reduce evaporation, increase the rate of water intake, and help to control both wind and water erosion. Crosswind tillage, wind-water tillage, or wind-water stripcropping is also necessary on long slopes or in fields where runoff accumulates. Seeded waterways will safely remove excess runoff. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIs-1

Moderately deep, gently sloping silt loams

These soils occur on ridgetops, mainly in the central and southern parts of the county. The areas increase in size toward the south. Drainage is good, and permeability is moderate. Slopes are gentle, and runoff is slow, but there is a slight hazard of erosion. The moisture-supplying capacity is fair to good, fertility is moderate, and workability is good to very good. The soils in this unit are—

- Condon silt loam, 1 to 7 percent slopes.
- Ritzville silt loam, 2 to 7 percent slopes.
- Walla Walla silt loam, moderately deep, 3 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes.

Use, suitability, and management.—All of these soils are well suited to both wheat and barley, except the Ritzville soil, which is only fairly well suited to barley. All are moderately well suited to alfalfa and perennial grasses for pasture and hay. The Ritzville soil has been included in this unit because it is the only soil of its kind in the county and is limited in extent.

Stubble-mulch tillage slows runoff, increases the rate of water intake, and helps to control erosion. On long slopes, cross-slope or contour tillage may be necessary. Where drainageways and waste areas cannot be crossed with farm equipment, field diversions that carry off excess water are more suitable than stripcropping.

Normally, the annual precipitation fills all of these soils except the Ritzville to moisture capacity. Consequently, if nitrogen fertilizer is applied, annual cropping is a practical method of erosion control. Nitrogen fertilizer in a fallow-grain rotation, however, will increase grain yields only if rainfall is higher than normal.

The control of both annual and perennial weeds helps to conserve soil moisture. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIs-2

Deep, nearly level, mildly to strongly alkaline alluvial soils

There is only one soil in this unit, Hermiston loam, 0 to 5 percent slopes. This soil occurs along streams throughout all parts of the county. Drainage is good, and permeability is moderate. Runoff is slow. Small areas are wet, strongly alkaline, or gravelly. Streambank cutting and entrenching are hazards in most areas, but wind, sheet, and rill erosion are slight. Overflow is not a problem. The moisture-supplying capacity is good, fertility is high, and workability is very good.

Use, suitability, and management.—Except for a few areas that are subirrigated, this soil is only fairly well suited to wheat and barley. It is moderately well suited to perennial grasses and alfalfa for hay and pasture.

Stubble-mulch tillage and grass-legume rotations will slow surface runoff, increase the rate of water intake, and help to control erosion. Aftermath grazing should be controlled to prevent the depletion of stubble. Streambank protection and channel improvement are necessary to prevent and to heal gullies. Irrigation is feasible in some areas. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IIIc-1

Deep and very deep, gently sloping coarse silt loams, very fine sandy loams, and ashy soils

These soils occur mainly on ridgetops and in broad swales in the northern part of the county, but there are a few areas scattered throughout the southern part. Drainage is good, and permeability is moderately rapid. Slopes are gentle, and runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is slight to severe. The moisture-supplying capacity is good, fertility is moderate to high, and workability is very good. The soils in this unit are—

- Walla Walla silt loam, coarse solum, deep, 3 to 7 percent slopes.
- Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes.
- Walvan loam, 2 to 10 percent slopes.

Use, suitability, and management.—These soils are well suited to wheat but only fairly well suited or poorly suited to barley. Yields of alfalfa and perennial grasses for hay or pasture are sufficient to make these crops suitable for inclusion in a long rotation.

Stubble-mulch tillage will slow surface runoff, increase the rate of water intake, and help to control erosion. In critical areas, crosswind farming, stripcropping, or field windbreaks may be necessary to control wind erosion. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVe–1

Moderately deep, steep silt loams on north-facing slopes

These soils occur in nearly all parts of the county except between Wasco and the Columbia River. Runoff is medium to very rapid, and the hazard of water erosion is moderate to severe. The moisture-supplying capacity is good, fertility is moderate, and workability is poor. In some places the soils are not stable and slip when wet. The soils in this unit are—

- Condon silt loam, 20 to 35 percent north slopes.
- Ritzville silt loam, moderately deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 20 to 35 percent north slopes.

Use, suitability, and management.—These soils are moderately well suited to wheat and barley and moderately well suited to perennial grasses and alfalfa for hay and pasture. Because of the steep slopes, however, they are best suited to permanent forage plants.

Stubble-mulch tillage is desirable but is difficult because of steep slopes and wetness late in spring. Additional conservation practices, such as stripcropping, cross-slope or contour tillage, or diversion terraces, may be necessary in some areas. Small grain usually responds to nitrogen fertilizer.

Practices that control both annual and perennial weeds are widely used. Improved methods of controlling annual cheatgrass are being tested.

Capability unit IVe–2

Moderately deep, moderately steep silt loams on south-facing slopes

These soils occur in the northern and central parts of the county. Runoff is medium, and the erosion hazard is moderate. The moisture-supplying capacity is fair, fertility is moderate, and workability is good. The soils in this unit are—

- Walla Walla silt loam, moderately deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes.

Use, suitability, and management.—These soils are poorly suited to dryland wheat and barley. They are fairly well suited to perennial grasses and alfalfa for pasture and hay. Because of the influence of a southern exposure, crops mature earlier and yields are lower than on similar soils that have a northern exposure.

Stubble-mulch tillage slows surface runoff, increases the rate of water intake, and helps to control erosion. Contour tillage and stripcropping are also needed in places. Nitrogen fertilizer increases grain yields only if rainfall is higher than normal during the crop year.

Mechanical and chemical methods of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVe–3

Very deep and deep, steep coarse silt loams on south-facing slopes

These soils occur on steep south-facing slopes in the northern part of the county. Runoff is rapid, and the hazard of erosion is moderate to severe. The moisture-supplying capacity is good; fertility is high; and workability is poor because of the steep slopes. The soils in this unit are—

- Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent south slopes.
- Walla Walla silt loam, coarse solum, deep, 20 to 35 percent south slopes.

Use, suitability, and management.—These soils are moderately well suited to wheat and fairly well suited to barley. Yields of alfalfa and perennial grasses for hay and pasture are sufficient to make these crops suitable for inclusion in a long rotation.

Stubble-mulch tillage slows surface runoff, increases the rate of water intake, and helps to control erosion, but it is difficult because of the steep slopes. On short slopes, crosswind tillage generally is needed in addition to stubble mulching. On long slopes, a combination of wind-water stripcropping may be necessary. Nitrogen is the only nutrient to which small grain responds.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVe–4

Moderately deep, moderately steep and steep coarse silt loams on south-facing slopes

These soils occur on south-facing slopes in the northern part of the county. Runoff is medium to rapid, and the hazard of both wind and water erosion is moderate to severe. The moisture-supplying capacity is low, fertility is moderate, and workability is fair to poor. The soils in this unit are—

- Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 20 to 35 percent south slopes.

Use, suitability, and management.—These soils are poorly suited to wheat and barley but fairly well suited to alfalfa and perennial grasses for pasture and hay. Because of the effects of a southern exposure, crops mature earlier and yields are lower than on similar soils on north-facing slopes.

Stubble-mulch tillage reduces surface runoff, reduces evaporation, increases the rate of water intake, and helps to control both wind and water erosion. Cross-slope tillage and stubble-mulch tillage are effective methods of slowing surface runoff and controlling wind erosion on short slopes. On long slopes, a combination of wind-water stripcropping may be necessary. Nitrogen fertilizer will increase grain yields only if rainfall is higher than normal during the crop year.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVe-5

Moderately deep, gently sloping to steeply sloping very fine sandy loams

These soils are in the extreme northern part of the county. Drainage is good, permeability is moderately rapid, and runoff is slow to medium. The moisture-supplying capacity is low; fertility is moderate; and workability is good to poor, depending on the slope. Wind erosion is a moderate to severe hazard. The soils in this unit are—

- Walla Walla very fine sandy loam, moderately deep, 3 to 7 percent slopes.
- Walla Walla very fine sandy loam, moderately deep, 7 to 20 percent south slopes.
- Walla Walla very fine sandy loam, moderately deep, 20 to 35 percent south slopes.

Use, suitability, and management.—These soils are poorly suited to wheat and barley and fairly well suited to perennial grasses and alfalfa for pasture and hay.

Stubble-mulch tillage, crosswind tillage, and wind stripcropping reduce the force of surface winds and increase the effectiveness of available moisture. Nitrogen fertilizer increases grain yields only if rainfall is higher than normal during the crop year.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVe-6

Moderately deep, gently sloping and moderately steep silt loams on south-facing slopes

These soils occur on ridgetops and on south-facing slopes in the extreme east-central part of the county, known locally as "Starvation Point." Drainage is good, and permeability is moderate. Runoff is slow to medium, and the hazard of water erosion is slight. The moisture-supplying capacity is fair to low, fertility is moderate, and workability is good. The soils in this unit are—

- Ritzville silt loam, moderately deep, 2 to 7 percent slopes.
- Ritzville silt loam, moderately deep, 7 to 20 percent south slopes.

Use, suitability, and management.—These soils are poorly suited to wheat and barley and only fairly well suited to perennial grasses and alfalfa for pasture and hay. Because of the effects of a southern exposure and the relative shallowness of the soils, crops mature earlier and yields are lower than on similar but deeper soils on north-facing slopes. Early and limited precipitation and hot, drying easterly winds while the grain is developing also cause lower yields.

Stubble-mulch tillage slows surface runoff, increases the rate of water intake, and helps to control both wind and water erosion. Aftermath grazing should be controlled so that there is adequate residue for mulch. Marginal areas should be seeded to permanent pasture. Nitrogen fertilizers have not greatly increased yields.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVe-7

Deep and moderately deep, gently sloping to steeply sloping very fine sandy loams, coarse silt loams, and silt loams.

These soils are in the northern part of the county. Drainage is good, and permeability is moderate to moderately rapid. Runoff is slow to medium. The hazard of wind erosion is slight to moderate, and there is a slight hazard of water erosion on the Ritzville soil. The moisture-supplying capacity is fair; fertility is moderate to high; and workability is good to poor, depending on the slope. The soils in this unit are—

- Ritzville silt loam, moderately deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes.
- Walla Walla very fine sandy loam, deep, 7 to 20 percent south slopes.
- Walla Walla very fine sandy loam, deep, 20 to 35 percent south slopes.

Use, suitability, and management.—These soils are moderately well suited to dryland wheat but poorly suited to spring barley. They are also moderately well suited to alfalfa and perennial grasses for hay and pasture.

Stubble-mulch tillage slows the force of the wind, reduces evaporation, and helps to control erosion. In critical areas, however, wind stripcropping is necessary. In many places, field windbreaks also help to reduce wind velocity. Cross-slope or contour tillage is needed on the Ritzville soil. Nitrogen fertilizer is the only nutrient to which small grain responds. On the Ritzville soil, it increases grain yields only in years when rainfall is higher than normal during the crop year.

Mechanical and chemical means of controlling both annual and perennial weeds have been developed and are widely used. Methods of controlling annual cheatgrass are being tested.

Capability unit IVw-1

Very deep, nearly level, poorly drained soils

There is only one soil in this unit, Pedigo silt loam. This soil occurs on nearly level bottom lands in Finnegan Canyon and in the vicinity of Grass Valley. Drainage is poor, and permeability is slow. Runoff is very slow and is ponded in places. The hazard of erosion is slight. The moisture-supplying capacity is high; fertility is moderate; and workability is poor to very poor because of restricted drainage.

Use, suitability, and management.—This soil is well suited to native grasses for hay and pasture. It produces an abundance of hay and forage during the summer when the adjacent range is not suitable for grazing, but in spring grazing is restricted by wetness.

The protection of streambanks and the improvement of channels are necessary to prevent and heal gullying.

Capability unit VIe–1

Sandy, sloping, or shallow soils

The soils in this unit are—

- Condon silt loam, shallow variant, 3 to 15 percent slopes.
- Condon silt loam, shallow variant, 15 to 35 percent north slopes.
- Sagemoor silt loam, 5 to 40 percent slopes.
- Sandy alluvial land.
- Starbuck stony silt loam, 4 to 20 percent slopes.

These soils are not suited to cultivated crops, but they are fairly well suited to improved pasture. For use and management suggestions, see the subsections "Hay and Pasture Seedings" and "Range."

Capability unit VIIe–1

Coarse-textured soils

There is only one soil in this unit, Quincy loamy fine sand, 0 to 20 percent slopes. This sandy soil is not suited to cultivated crops. It can be used for native range. For use and management suggestions, see the subsection "Range."

Capability unit VIIs–1

Sloping, stony, or rocky soils

The soils in this unit are—

- Bakeoven very stony loam, 2 to 20 percent slopes.
- Condon-Bakeoven complex, 2 to 20 percent slopes.
- Kuhl stony silt loam, 10 to 35 percent north slopes.
- Kuhl very rocky very fine sandy loam, 3 to 7 percent slopes.
- Kuhl very stony very fine sandy loam, 7 to 35 percent north slopes.
- Lickskillet very stony loam, 7 to 40 percent south slopes.
- Lickskillet extremely stony loam, 40 to 70 percent south slopes.
- Lickskillet extremely stony loam, 40 to 70 percent north slopes.
- Nansene rocky silt loam, 35 to 70 percent slopes.
- Starbuck-Bakeoven complex, 2 to 20 percent slopes.
- Starbuck very stony silt loam, 7 to 40 percent south slopes.
- Starbuck extremely stony silt loam, 40 to 70 percent south slopes.
- Wrentham rocky silt loam, 35 to 70 percent slopes.

These soils are best suited to native range. In some places, Kuhl stony silt loam, the Condon-Bakeoven complex, and the Starbuck-Bakeoven complex can be used for hay and pasture. Otherwise, these soils are not suited to cultivated crops, hay, or pasture. For use and management suggestions, see the subsection "Range."

Capability unit VIIIe–1

Dune land

This unit is made up entirely of Dune land. This land is not suitable for crops, pasture, hay, or range. Improved perennial grasses or nursery-grown plants or clones of Volga wildrye, planted 20 inches apart in rows that are spaced 20 inches apart, would stabilize these dunes if grazing is restricted.

Capability unit VIIIs–1

Land types consisting mainly of coarse fragments

This unit consists of—

- Riverwash.
- Rock land.
- Rock outcrop and rubble land.

These land types are not suited to crops, pasture, hay, or range.

Hay and Pasture Seedings

Suggested varieties and mixtures for hay and pasture seedings are given both for dryland and for irrigated farming. These varieties were considered the most suitable at the time this survey was made, but new varieties or improvements in management may result in changes at any time.

Dryland hay and pasture seedings

Soils that can be seeded by practical methods as dryland are grouped according to their suitability for various grasses and legumes. Suggested varieties and mixtures are given for each group. Soils in capability classes VII and VIII are not included in these groups.

GROUP 1

This group consists of soils that have high to very high moisture-supplying capacity. The soils are—

- Condon silt loam, deep, 1 to 7 percent slopes.
- Condon silt loam, deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, very deep, 3 to 7 percent slopes.
- Walla Walla silt loam, very deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, very deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, deep, 3 to 7 percent slopes.
- Walla Walla silt loam, deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes.
- Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, coarse solum, deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, very deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, low rainfall, very deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, low rainfall, deep, 3 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, deep, 7 to 20 percent north slopes.
- Walla Walla very fine sandy loam, deep, 7 to 20 percent north slopes.
- Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes.

Following are suggested varieties or mixtures for the seeding of hayfields, pastures, or waterways and the rates of seeding, in pounds per acre, for the soils in group 1.

Short-term hay.—Either Greenar intermediate wheatgrass (8 pounds) or Topar pubescent wheatgrass (8 pounds), mixed with Ladak alfalfa (4 pounds). Mixed seeding, in rows spaced 14 inches apart, or alternate-row seeding.

Short-term spring pasture.—Either Greenar intermediate wheatgrass (8 pounds) or Topar pubescent wheatgrass (8 pounds). Fall seeding preferably in rows spaced 14 inches apart.

Short-term summer pasture.—Either Greenar intermediate wheatgrass (8 pounds) or Topar pubescent wheatgrass (8 pounds). Fall seeding, preferably in rows spaced 14 inches apart. OR, Greenar intermediate wheatgrass (8 pounds) or Topar pubescent wheatgrass (8 pounds), mixed with Ladak alfalfa (2 pounds). Mixed seeding, preferably in rows spaced 14 inches apart.

Long-term or permanent hay.—Sherman big bluegrass (6 pounds), Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with Ladak alfalfa (4 pounds). Mixed seeding, in rows spaced 14 inches apart, or alternate-row seeding.

Long-term or permanent spring pasture.—Sherman big bluegrass (6 pounds), Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with hard fescue (4 pounds) or with sheep fescue (4 pounds). Fall seeding, preferably in rows spaced 14 inches apart.

Long-term or permanent summer pasture.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with Nomad alfalfa (2 pounds). Mixed seeding, preferably in rows spaced 14 inches apart.

Grassed waterways.—Either Greenar intermediate wheatgrass (10 pounds) or Topar pubescent wheatgrass (10 pounds).

GROUP 2

This group consists of soils that have good moisture-supplying capacity. The soils are—

- Condon silt loam, 7 to 20 percent north slopes.
- Condon silt loam, 20 to 35 percent north slopes.
- Hermiston loam, 0 to 5 percent slopes.
- Ritzville silt loam, 7 to 20 percent north slopes.
- Ritzville silt loam, moderately deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, very deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, moderately deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes.
- Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent south slopes.
- Walla Walla silt loam, coarse solum, deep, 3 to 7 percent slopes.
- Walla Walla silt loam, coarse solum, deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, deep, 20 to 35 percent south slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, low rainfall, deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent north slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 20 to 35 percent north slopes.
- Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes.
- Walvan loam, 2 to 10 percent slopes.

Following are suggested varieties or mixtures for the seeding of hayfields, pastures, or waterways and the rates of seeding, in pounds per acre, for the soils in group 2.

Short-term hay.—Topar pubescent wheatgrass (8 pounds), mixed with Ladak alfalfa (4 pounds). Mixed seeding, in rows spaced 14 inches apart, or alternate-row seeding.

Short-term spring pasture. — Topar pubescent wheatgrass (8 pounds). Fall seeding, preferably in rows spaced 14 inches apart.

Short-term summer pasture.—Topar pubescent wheatgrass alone (8 pounds). Fall seeding, preferably in rows spaced 14 inches apart. OR, Topar pubescent wheatgrass (8 pounds), mixed with Ladak alfalfa (2 pounds). Mixed seeding, preferably in rows spaced 14 inches apart.

Long-term or permanent hay.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with Ladak alfalfa (4 pounds). Mixed seeding, in rows spaced 14 inches apart, or alternate-row seeding. OR, Sherman big bluegrass alone (6 pounds). Fall seeding, preferably in rows spaced 14 inches apart.

Long-term or permanent spring pasture.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with bulbous bluegrass (2 pounds). Fall seeding, preferably in rows spaced 14 inches apart. OR, Sherman big bluegrass alone (6 pounds).

Long-term or permanent summer pasture.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with Nomad alfalfa (2 pounds). Mixed seeding, preferably in rows spaced 14 inches apart.

Grassed waterways.—Topar pubescent wheatgrass (10 pounds).

GROUP 3

This group consists of soils that have low to fair moisture-supplying capacity. The soils are—

- Condon silt loam, 1 to 7 percent slopes.
- Condon silt loam, shallow variant, 3 to 15 percent slopes.
- Condon silt loam, shallow variant, 15 to 35 percent north slopes.
- Ritzville silt loam, 2 to 7 percent slopes.
- Ritzville silt loam, moderately deep, 2 to 7 percent slopes.
- Ritzville silt loam, moderately deep, 7 to 20 percent north slopes.
- Ritzville silt loam, moderately deep, 7 to 20 percent south slopes.
- Sagemoor silt loam, 5 to 40 percent slopes.
- Sandy alluvial land.
- Starbuck stony silt loam, 4 to 20 percent slopes.
- Walla Walla silt loam, moderately deep, 3 to 7 percent slopes.
- Walla Walla silt loam, moderately deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent south slopes.
- Walla Walla silt loam, coarse solum, moderately deep, 20 to 35 percent south slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes.
- Walla Walla very fine sandy loam, deep, 7 to 20 percent south slopes.
- Walla Walla very fine sandy loam, deep, 20 to 35 percent south slopes.
- Walla Walla very fine sandy loam, moderately deep, 3 to 7 percent slopes.

Walla Walla very fine sandy loam, moderately deep, 7 to 20 percent south slopes.
Walla Walla very fine sandy loam, moderately deep, 20 to 35 percent south slopes.

Because of the low to fair moisture-supplying capacity, it is not considered practical to grow hay on the soils in group 3. Following are suggested varieties or mixtures for seeding pastures and waterways and the rates of seeding, in pounds per acre, for these soils.

Short-term spring pasture.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with bulbous bluegrass (2 pounds). Fall seeding, preferably in rows spaced 14 inches apart.

Short-term summer pasture.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with Ladak alfalfa (2 pounds). Mixed seeding, preferably in rows spaced 14 inches apart.

Long-term or permanent summer pasture.—Whitmar tall wheatgrass (8 pounds), Nordan crested wheatgrass (6 pounds), or Siberian wheatgrass (6 pounds), mixed with Nomad alfalfa (2 pounds). Mixed seeding, preferably in rows spaced 14 inches apart.

Grassed waterways.—Either Topar pubescent wheatgrass (10 pounds) or Fairway crested wheatgrass (6 pounds), mixed with bulbous bluegrass (2 pounds).

GROUP 4

This group consists of one miscellaneous land type, Clayey basin land. Because this land is fine textured and is excessively wet in spring, it is best suited to Alkar tall wheatgrass, seeded at a rate of 8 pounds per acre.

GROUP 5

This group consists of only one soil, Pedigo silt loam. This soil is poorly drained and moderately to strongly alkaline. It is suited to either Alkar tall wheatgrass or Alta tall fescue, at 8 pounds per acre, mixed with yellow sweetclover, at 4 pounds per acre.

Irrigated hay and pasture seedings

Soils that are suitable for seeding to grasses and legumes under irrigation are—

Clayey basin land.
All Condon soils, except Condon-Bakeoven complex, 2 to 20 percent slopes.
Hermiston loam, 0 to 5 percent slopes.
Quincy loamy fine sand, 0 to 20 percent slopes.
All Ritzville soils.
Sandy alluvial land.
All Walla Walla soils.

The following varieties or mixtures are suitable for hay or pasture if the supply of irrigation water is adequate. If the supply is limited, intermediate wheatgrass should be grown instead of orchardgrass, Manchar smooth brome, or Alta tall fescue. The rate of seeding is in pounds per acre.

Hay.—(1) Orchardgrass, 8 pounds, mixed with Ranger alfalfa, 4 pounds; (2) Manchar smooth brome, 10 pounds, mixed with Ranger alfalfa, 4 pounds; or (3) Ranger alfalfa alone, 8 pounds.

Pasture.—(1) Orchardgrass, 8 pounds, mixed with Ranger alfalfa, 3 pounds; (2) orchardgrass, 8 pounds, mixed with ladino clover, 1 pound; (3) Alta tall fescue, 12 pounds, mixed with Ranger alfalfa, 3 pounds; (4) Alta tall fescue, 12 pounds, mixed with ladino clover, 1 pound; (5) orchardgrass, 6 pounds, mixed with Alta tall fescue, 8 pounds, and with Ranger alfalfa, 3 pounds; (6) orchardgrass, 6 pounds, mixed with Alta tall fescue, 8 pounds, and with ladino clover, 1 pound; (7) orchardgrass alone, 10 pounds; or (8) Alta tall fescue alone, 12 pounds.

Estimated Yields and Management Practices

Table 2 shows the estimated yields of dryfarmed wheat for the year of harvest, which is every other year. These estimates are based on a 10-year period, from 1949 to 1959. During this period, the average production was at an all-time high.

In Sherman County, two levels of management are described for the purpose of estimating yields and damage to soils. They are identified as A and B.

The A level is the most common combination of management practices used by most farmers. Generally, the rotation is black fallow followed by grain. A moldboard plow is used, and the deeper soils are fertilized with nitrogen.

The B level is a superior combination of management practices used by some farmers. Generally, the rotation is stubble-mulch fallow followed by grain. Sweeps or chisels are used, and the deeper soils are fertilized with nitrogen.

In table 2, no distinction in yields is made between the A, or common, level of management and the B, or superior, level, because both were equally productive. Under the A level, however, continued erosion will eventually reduce productivity and lower crop yields. Under the B level, soil-stabilizing practices will help to maintain productivity and generally sustain yields.

Yields of native forage are given for each range site in the subsection "Range."

For the soils in capability classes II through IV, table 3 shows the specific combination of practices under the two levels of management that will produce the wheat yields given in table 2. Table 3 will be of greatest use immediately upon release of this report. New developments in crop breeding, tillage, fertilization, and the control of pests and diseases will in time make obsolete much of the information on management given in table 3. However, State and Federal farm advisory officials are always ready to provide the latest information available.

TABLE 2.—*Estimated average acre yields of dryfarmed wheat*

[Yields shown are for the year of harvest, which is every 2 years. If no yield is shown, the soil commonly is not used for growing wheat]

Symbol	Soil	Dry-farmed wheat	Capability unit
		Bushels	*Symbol*
BaB	Bakeoven very stony loam, 2 to 20 percent slopes		VIIs-1
Ca	Clayey basin land	32	IIw-1
CbA	Condon silt loam, 1 to 7 percent slopes	23	IIIs-1
CbBN	Condon silt loam, 7 to 20 percent north slopes	24	IIIe-3
CbCN	Condon silt loam, 20 to 35 percent north slopes	24	IVe-1
CdA	Condon silt loam, deep, 1 to 7 percent slopes	37	IIc-1
CdBN	Condon silt loam, deep, 7 to 20 percent north slopes	41	IIIe-1
CcB	Condon silt loam, shallow variant, 3 to 15 percent slopes		VIe-1
CcCN	Condon silt loam, shallow variant, 15 to 35 percent north slopes		VIe-1
CeB	Condon-Bakeoven complex, 2 to 20 percent slopes		VIIs-1
De	Dune land		VIIIe-1
HeA	Hermiston loam, 0 to 5 percent slopes	25	IIIs-2
KhCN	Kuhl stony silt loam, 10 to 35 percent north slopes		VIIs-1
KrB	Kuhl very rocky very fine sandy loam, 3 to 7 percent slopes		VIIs-1
KvCN	Kuhl very stony very fine sandy loam, 7 to 35 percent north slopes		VIIs-1
LiCS	Lickskillet very stony loam, 7 to 40 percent south slopes		VIIs-1
LsDS	Lickskillet extremely stony loam, 40 to 70 percent south slopes		VIIs-1
LsDN	Lickskillet extremely stony loam, 40 to 70 percent north slopes		VIIs-1
NaD	Nansene rocky silt loam, 35 to 70 percent slopes		VIIs-1
Pe	Pedigo silt loam		IVw-1
QnB	Quincy loamy fine sand, 0 to 20 percent slopes		VIIe-1
RiA	Ritzville silt loam, 2 to 7 percent slopes	25	IIIs-1
RiBN	Ritzville silt loam, 7 to 20 percent north slopes	30	IIIe-3
RtA	Ritzville silt loam, moderately deep, 2 to 7 percent slopes	14	IVe-6
RtBN	Ritzville silt loam, moderately deep, 7 to 20 percent north slopes	20	IVe-7
RtBS	Ritzville silt loam, moderately deep, 7 to 20 percent south slopes	14	IVe-6
RtCN	Ritzville silt loam, moderately deep, 20 to 35 percent north slopes	22	IVe-1
Rv	Riverwash		VIIIs-1
Rw	Rock outcrop and rubble land		VIIIs-1
Rx	Rock land		VIIIs-1
SaC	Sagemoor silt loam, 5 to 40 percent slopes		VIe-1
Sd	Sandy alluvial land		VIe-1
StCS	Starbuck very stony silt loam, 7 to 40 percent south slopes		VIIs-1
SrB	Starbuck stony silt loam, 4 to 20 percent slopes		VIe-1
SvDS	Starbuck extremely stony silt loam, 40 to 70 percent south slopes		VIIs-1
SxB	Starbuck-Bakeoven complex, 2 to 20 percent slopes		VIIs-1
WaA	Walla Walla silt loam, very deep, 3 to 7 percent slopes	45	IIc-1
WaBN	Walla Walla silt loam, very deep, 7 to 20 percent north slopes	45	IIIe-1
WaBS	Walla Walla silt loam, very deep, 7 to 20 percent south slopes	40	IIIe-2
WaCN	Walla Walla silt loam, very deep, 20 to 35 percent north slopes	45	IIIe-1
WbA	Walla Walla silt loam, deep, 3 to 7 percent slopes	35	IIc-1
WbBN	Walla Walla silt loam, deep, 7 to 20 percent north slopes	43	IIIe-1
WbBS	Walla Walla silt loam, deep, 7 to 20 percent south slopes	35	IIIe-2
WcA	Walla Walla silt loam, moderately deep, 3 to 7 percent slopes	22	IIIs-1
WcBN	Walla Walla silt loam, moderately deep, 7 to 20 percent north slopes	25	IIIe-3
WcBS	Walla Walla silt loam, moderately deep, 7 to 20 percent south slopes	15	IVe-2
WcCN	Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes	26	IVe-1
WdA	Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes	35	IIIe-4
WdBN	Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent north slopes	38	IIIe-5
WdBS	Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent south slopes	33	IIIe-5
WdCN	Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent north slopes	43	IIIe-5
WdCS	Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent south slopes	26	IVe-3
WeA	Walla Walla silt loam, coarse solum, deep, 3 to 7 percent slopes	25	IIIc-1
WeBN	Walla Walla silt loam, coarse solum, deep, 7 to 20 percent north slopes	36	IIIe-5
WeBS	Walla Walla silt loam, coarse solum, deep, 7 to 20 percent south slopes	25	IIIe-6
WeCN	Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes	41	IIIe-5
WeCS	Walla Walla silt loam, coarse solum, deep, 20 to 35 percent south slopes	24	IVe-3
WgA	Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes	20	IVe-7
WgBN	Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent north slopes	23	IIIe-6
WgBS	Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent south slopes	14	IVe-4
WgCS	Walla Walla silt loam, coarse solum, moderately deep, 20 to 35 percent south slopes	14	IVe-4
WhA	Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes	38	IIc-1

TABLE 2.—*Estimated average acre yields of dryfarmed wheat*—Continued

[Yields shown are for the year of harvest, which is every 2 years. If no yield is shown, the soil commonly is not used for growing wheat]

Symbol	Soil	Dry-farmed wheat	Capability unit	Symbol	Soil	Dry-farmed wheat	Capability unit
		Bushels	*Symbol*			*Bushels*	*Symbol*
WhBN	Walla Walla silt loam, low rainfall, very deep, 7 to 20 percent north slopes	43	IIIe-1	WnBN	Walla Walla very fine sandy loam, deep, 7 to 20 percent north slopes	40	IIIe-4
WhCN	Walla Walla silt loam, low rainfall, very deep, 20 to 35 percent north slopes	43	IIIe-1	WnBS	Walla Walla very fine sandy loam, deep, 7 to 20 percent south slopes	20	IVe-7
WkA	Walla Walla silt loam, low rainfall, deep, 3 to 7 percent slopes	33	IIc-1	WnCN	Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes	40	IIIe-4
WkBN	Walla Walla silt loam, low rainfall, deep, 7 to 20 percent north slopes	35	IIIe-1	WnCS	Walla Walla very fine sandy loam, deep, 20 to 35 percent south slopes	20	IVe-7
WkBS	Walla Walla silt loam, low rainfall, deep, 7 to 20 percent south slopes	28	IIIe-3	WoA	Walla Walla very fine sandy loam, moderately deep, 3 to 7 percent slopes	14	IVe-5
WmA	Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes	22	IIIs-1	WoBS	Walla Walla very fine sandy loam, moderately deep, 7 to 20 percent south slopes	14	IVe-5
WmBN	Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent north slopes	23	IIIe-3	WoCS	Walla Walla very fine sandy loam, moderately deep, 20 to 35 percent south slopes	14	IVe-5
WmBS	Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes	14	IVe-2	WvB	Walvan loam, 2 to 10 percent slopes	25	IIIc-1
WmCN	Walla Walla silt loam, low rainfall, moderately deep, 20 to 35 percent north slopes	26	IVe-1	WxD	Wrentham rocky silt loam, 35 to 70 percent slopes	--------	VIIs-1
WnA	Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes	30	IIIc-1				

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*

Capability unit IIc-1

Soils	Practice	Management level A	Management level B
Soils in capability unit IIc-1: Condon silt loam, deep, 1 to 7 percent slopes. Walla Walla silt loam, very deep, 3 to 7 percent slopes. Walla Walla silt loam, deep, 3 to 7 percent slopes. Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. Walla Walla silt loam, low rainfall, deep, 3 to 7 percent slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	30 to 40 pounds of nitrogen applied during fallow.	40 to 50 pounds of nitrogen applied during fallow; or 20 to 25 pounds of nitrogen applied during fallow and 20 to 25 pounds applied early in spring of crop year.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IIc–1

Soils	Practice	Management level A	Management level B
Soils in capability unit IIc–1—Continued	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2–4–D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2–4–D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2–4–D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2–4–D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble-mulch tillage; cross-slope or contour tillage; cross-slope or contour stripcropping on long slopes; grassed waterways; grain waterways on small drainageways.
	Estimated average annual soil loss per acre.	10 tons.	3 tons.

Capability unit IIw–1

Soils	Practice	Management level A	Management level B
Soils in capability unit IIw–1: Clayey basin land.	Rotation	Black fallow; wheat.	Black fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue, plus additional mulch material.
	Fertilization	40 to 50 pounds of nitrogen applied during fallow.	40 to 50 pounds of nitrogen applied during fallow; or 20 to 25 pounds of nitrogen applied during fallow and 20 to 25 pounds applied early in spring of crop year.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety, at the rate of 40 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2–4–D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2–4–D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2–4–D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2–4–D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage.	Cloddy fallow; minimum tillage.
	Estimated average annual soil loss per acre.	3 to 4 tons.	2 tons.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability units IIIe-1 and IIIe-2

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIe-1: Condon silt loam, deep, 7 to 20 percent north slopes. Walla Walla silt loam, very deep, 7 to 20 percent north slopes. Walla Walla silt loam, very deep, 20 to 35 percent north slopes. Walla Walla silt loam, deep, 7 to 20 percent north slopes. Walla Walla silt loam, low rainfall, very deep, 7 to 20 percent north slopes. Walla Walla silt loam, low rainfall, very deep, 20 to 35 percent north slopes. Walla Walla silt loam, low rainfall, deep, 7 to 20 percent north slopes. Soils in capability unit IIIe-2: Walla Walla silt loam, very deep, 7 to 20 percent south slopes. Walla Walla silt loam, deep, 7 to 20 percent south slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	30 to 40 pounds of nitrogen applied during fallow.	40 to 50 pounds of nitrogen applied during fallow; or 20 to 25 pounds of nitrogen applied during fallow and 20 to 25 pounds applied early in spring of crop year.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety, at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble mulch; cross-slope or contour tillage; cross-slope or contour stripcropping; diversions; grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	26 to 32 tons.	3 to 5 tons.

Capability unit IIIe-3

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIe-3: Condon silt loam, 7 to 20 percent north slopes. Ritzville silt loam, 7 to 20 percent north slopes. Walla Walla silt loam, moderately deep, 7 to 20 percent north slopes. Walla Walla silt loam, low rainfall, deep, 7 to 20 percent south slopes. Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent north slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	20 to 30 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IIIe-3

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIe-3—Continued	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble mulch; cross-slope or contour tillage; cross-slope or contour stripcropping; diversions; (two latter practices not applicable on Ritzville soil); grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	26 tons on all soils except the Ritzville soil, for which no data are available.	4 to 5 tons on all soils except the Ritzville soil, for which no data are available.

Capability unit IIIe-4

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIe-4: Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes. Walla Walla very fine sandy loam, deep, 7 to 20 percent north slopes. Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	30 to 40 pounds of nitrogen applied during fallow.	40 to 50 pounds of nitrogen applied during fallow; or 20 to 25 pounds of nitrogen applied during fallow, and 20 to 25 pounds applied early in spring of crop year.
	Seedbed preparation	Moldboard or disk plow; springtooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways on Walla Walla soil that has a coarse solum.	Stubble mulch; crosswind tillage; wind stripcropping; grassed waterways and grain waterways on small drains on Walla Walla soil that has a coarse solum.
	Estimated average annual soil loss.	No data available.	No data available.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IIIe-5

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIe-5: Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent north slopes. Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent south slopes. Walla Walla silt loam, coarse solum, deep, 7 to 20 percent north slopes. Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes. Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent north slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	30 to 40 pounds of nitrogen applied during fallow.	40 to 50 pounds of nitrogen applied during fallow; or 20 to 25 pounds of nitrogen applied during fallow and 20 to 25 pounds applied early in spring of crop year.
	Seedbed preparation	Moldboard or disk plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble mulch; crosswind and cross-slope tillage; wind-water stripcropping; wind stripcropping; grassed waterways; grain waterways on small drainageways.
	Estimated average annual soil loss per acre.	8 to 15 tons by water; wind loss not measured.	2 to 4 tons by water; wind loss not measured.

Capability units IIIe-6 and IVe-3

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIe-6: Walla Walla silt loam, coarse solum, deep, 7 to 20 percent south slopes. Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent north slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
Soils in capability unit IVe-3: Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent south slopes. Walla Walla silt loam, coarse solum, deep, 20 to 35 percent south slopes.	Fertilization	0 to 30 pounds of nitrogen applied during fallow.	20 to 30 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard or disk plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability units IIIe-6 and IVe-3

Soils	Practice	Management level A	Management level B
Soils in capability units IIIe-6 and IVe-3—Continued	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble mulch; crosswind and cross-slope tillage; wind-water stripcropping; wind stripcropping; grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	8 to 15 tons by water; wind loss not measured.	2 to 4 tons by water; wind loss not measured.

Capability unit IIIs-1

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIs-1: Condon silt loam, 1 to 7 percent slopes. Walla Walla silt loam, moderately deep, 3 to 7 percent slopes. Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes. Ritzville silt loam, 2 to 7 percent slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	Not more than 20 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble mulch; cross-slope or contour tillage; cross-slope or contour stripcropping; diversions; (the two latter practices not applicable on Ritzville soil); grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	10 tons on all soils except the Ritzville soil, for which no data are available.	3 tons on all soils except the Ritzville soil, for which no data are available.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IIIs–2

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIs–2: Hermiston loam, 0 to 5 percent slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	30 to 40 pounds of nitrogen applied during fallow.	40 to 50 pounds of nitrogen applied during fallow; or 20 to 25 pounds of nitrogen applied during fallow and 20 to 25 pounds applied early in spring of crop year.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety, at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety, at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2–4–D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2–4–D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2–4–D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2–4–D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grains; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage.	Stubble mulch; interception diversions; stabilization of streambanks.
	Estimated average annual soil loss per acre.	No data available.	No data available.

Capability unit IIIc–1

Soils	Practice	Management level A	Management level B
Soils in capability unit IIIc–1: Walvan loam, 2 to 10 percent slopes. Walla Walla silt loam, coarse solum, deep, 3 to 7 percent slopes. Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	30 to 40 pounds of nitrogen applied during fallow.	30 to 40 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard or disk plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IIIc-1

Soils	Practice	Management level	
		A	B
Soils in capability unit IIIc-1—Continued	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways on Walla Walla soil that has a coarse solum.	Stubble mulch; crosswind tillage; wind stripcropping; grassed waterways and grain waterways on small drains on Walla Walla soil that has a coarse solum.
	Estimated average annual soil loss per acre.	0 to 5 tons by water; wind loss not measured.	0 to 1 ton by water; wind loss not measured.

Capability unit IVe-1

Soils	Practice	A	B
Soils in capability unit IVe-1: Condon silt loam, 20 to 35 percent north slopes. Ritzville silt loam, moderately deep, 20 to 35 percent north slopes. Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes. Walla Walla silt loam, low rainfall, moderately deep, 20 to 35 percent north slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	20 to 30 pounds of nitrogen applied during fallow on all soils except the Ritzville soil; not more than 20 pounds during fallow on the Ritzville soil.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread and rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble-mulch; cross-slope or contour tillage; cross-slope or contour stripcropping; diversions; grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	36 tons on all soils except the Ritzville soil, for which no data are available.	5 tons on all soils except the Ritzville soil, for which no data are available.

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TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IVe-2

Soils	Practice	Management level	
		A	B
Soils in capability unit IVe-2: Walla Walla silt loam, moderately deep, 7 to 20 percent south slopes. Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	Not more than 20 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread or rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble-mulch; cross-slope or contour tillage; cross-slope or contour stripcropping; diversions; grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	24 tons.	3 tons.

Capability unit IVe-4

Soils	Practice	A	B
Soils in capability unit IVe-4: Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent south slopes. Walla Walla silt loam, coarse solum, moderately deep, 20 to 35 percent south slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residues; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	Not more than 20 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard or disk plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread or rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IVe-4

Soils	Practice	Management level A	Management level B
Soils in capability unit IVe-4—Continued	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble-mulch; crosswind and cross-slope tillage; wind-water stripcropping; wind stripcropping; grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	8 to 15 tons by water; wind loss not measured.	2 to 4 tons by water; wind loss not measured.

Capability unit IVe-5

Soils	Practice	Management level A	Management level B
Soils in capability unit IVe-5: Walla Walla very fine sandy loam, moderately deep, 3 to 7 percent slopes. Walla Walla very fine sandy loam, moderately deep, 7 to 20 percent south slopes. Walla Walla very fine sandy loam, moderately deep, 20 to 35 percent south slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	Not more than 20 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard or disk plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread or rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage.	Stubble mulch; cross-wind tillage; wind stripcropping.
	Estimated average annual soil loss per acre.	No data available.	No data available.

Capability unit IVe-6

Soils	Practice	Management level A	Management level B
Soils in capability unit IVe-6: Ritzville silt loam, moderately deep, 2 to 7 percent slopes. Ritzville silt loam, moderately deep, 7 to 20 percent south slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest; leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Nitrogen not needed.	Nitrogen not needed.
	Seedbed preparation	Moldboard plow; spring-tooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread or rod weeder used when necessary to control weeds.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IVe-6

Soils	Practice	Management level A	Management level B
Soils in capability unit IVe-6—Continued	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways.	Stubble-mulch; cross-slope or contour tillage; grassed waterways; grain waterways on small drains.
	Estimated average annual soil loss per acre.	No data available.	No data available.

Capability unit IVe-7

Soils	Practice	Management level A	Management level B
Soils in capability unit IVe-7: Ritzville silt loam, moderately deep, 7 to 20 percent north slopes. Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes. Walla Walla very fine sandy loam, deep, 7 to 20 percent south slopes. Walla Walla very fine sandy loam, deep, 20 to 35 percent south slopes.	Rotation	Black fallow; wheat.	Stubble-mulch fallow; wheat.
	Residue utilization	Partial utilization of crop residue; chaff dumped and fed to livestock; uncontrolled pasturing of stubble following harvest.	Full utilization of crop residue; straw spreaders used on combines; controlled or no pasturing of stubble following harvest, leaving adequate stubble for mulch; tall stubble reduced by disking, harrowing, or beating in fall.
	Fertilization	Not more than 20 pounds of nitrogen applied during fallow.	Not more than 20 pounds of nitrogen applied during fallow.
	Seedbed preparation	Moldboard or disk plow; springtooth harrow and rod weeder used when necessary to control weeds.	Sweeps or chisels; skew tread or rod weeder used when necessary to control weeds.
	Seeding	Omar variety; at the rate of 60 pounds per acre; seeding date from Oct. 1 to Nov. 1; rows spaced 7 to 14 inches apart; population, 18 plants per square foot.	Omar variety; at the rate of 40 pounds per acre; seeding date from Sept. 15 to Oct. 15; rows spaced 14 inches apart; population, 12 plants per square foot.
	Weed control	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D and by spot treatments with TBA.	Annual grass by tillage; common broadleaf weeds by tillage and by applying 2-4-D as needed in spring of crop year; morning-glory and other perennial noxious weeds by applying 2-4-D, by spot treatments with TBA, or by full eradication with soil sterilants.
	Harvest	Bulk handling of grain; straw placed in rows and chaff dumped.	Bulk handling of grain; straw and chaff spread.
	Conservation practices (Practices may be used alone but commonly are used in combination.)	Cloddy fallow; minimum tillage; grain waterways on Walla Walla soils that have a coarse solum.	Stubble mulch; crosswind tillage and wind stripcropping on all soils except the Ritzville soil; grassed waterways and grain waterways on small drains on the Ritzville soil and on the Walla Walla soil that has a coarse solum; cross-slope or contour tillage on the Ritzville soil.

TABLE 3.—*Combination of practices under two levels of management for dryfarmed wheat*—Continued

Capability unit IVe–7

Soils	Practice	Management level A	Management level B
Soils in capability unit IVe–7—Continued	Estimated average annual soil loss per acre.	5 tons on the Walla Walla soil that has a coarse solum; no data available on other soils.	1 ton on the Walla Walla soil that has a coarse solum; no data available on the other soils.
Capability unit IVw–1			
Soils in capability unit IVw–1: Pedigo silt loam.	Rotation	Native hay and pasture.	Improved hay and pasture.
	Residue utilization	Not cultivated.	Not cultivated.
	Fertilization	None.	According to soil tests and field trials.
	Conservation practices	Native vegetation.	Improved vegetation; streambank stabilization.
	Estimated average annual soil loss per acre.	No data available.	No data available.
	All other practices	Not applicable.	Not applicable.

Range [2]

Approximately 42 percent of the acreage of the county is in range (fig. 16). Of this, about 37 percent produces usable forage. The rest consists of areas of rockslides, dunes, and riverwash. Most of the acreage occurs along the Deschutes and John Day Rivers, along drainageways to these rivers, and in areas where the soils are shallow in the southern part of the county.

The range in Sherman County differs from many other areas of range in that it is truly grassland, and broad-leaved herbs and shrubs are insignificant as forage plants.

According to studies made of relict areas, bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass made up nearly 90 percent of the original plant community. The rest consisted mostly of perennial forbs, or broad-leaved plants. Shrubs were sparse and occurred mainly on well-drained bottoms or on disturbed spots, such as badger mounds. Now, these more desirable forage grasses are dominant on only about a fourth of the range. On the rest, cheatgrass, Pacific fescue, fiddleneck, yarrow, phlox, daisy, pussytoes, buckwheat, big sagebrush, gray rabbitbrush, and matchweed have increased or invaded. Where the range is severely deteriorated, these plants have become dominant.

In the following list are some of the plants commonly found on the range in Sherman County.

[2] By E. William Anderson, range conservationist, Soil Conservation Service, Pendleton, Oregon, and Charles E. Poulton, range ecologist, Oregon Agricultural Experiment Station, Oregon State University, Corvallis, Oregon. Based upon interpretations made cooperatively by the authors in the Columbia Basin ecological area of Oregon. Supporting ecological data are unpublished research from Oregon Agricultural Experiment Station Project 362, "VEGETATION-SOIL RELATIONSHIPS AND PLANT SUCCESSION ON BRUSH-INFESTED RANGES IN OREGON," a project supported in part by Western Regional Project W–25, "ECOLOGY AND IMPROVEMENT OF BRUSH-INFESTED RANGES."

GRASSES

Local common name	*Scientific name*
Bentgrass, thin	*Agrostis diegoensis*
Bluegrass, big	*Poa ampla*
Bluegrass, cusick	*P. cusickii*
Bluegrass, Kentucky	*P. pratensis*
Bluegrass, Oregon	*P. vaseyochloa*
Bluegrass, Sandberg	*P. secunda*
Brome, mountain	*Bromus marginatus*
Brome, soft	*B. mollis*
Cheatgrass	*B. tectorum*
Fescue, Idaho	*Festuca idahoensis*
Fescue, meadow	*F. elatior*
Fescue, Pacific	*F. pacifica*
Giant wildrye	*Elymus cinereus*
Needlegrass, Thurber	*Stipa thurberiana*
Needle-and-thread	*S. comata*
Prairie junegrass	*Koeleria cristata*
Redtop	*Agrostis alva*
Saltgrass	*Distichlis stricta*
Squirreltail	*Sitanion hystrix*
Wheatgrass, bluebunch	*Agropyron spicatum*
Wheatgrass, slender	*A. trachycaulum*
Rush, baltic	*Juncus balticus*
Sedge, dry-meadow	*Carex* spp.
Sedge, Nebraska	*C. nebraskensis*
Sedge, ovalhead	*C. festivella*

FORBS

Agoseris, pale	*Agoseris glauca*
Avens	*Geum* spp.
Balsamroot, arrowleaf	*Balsamorhiza sagittata*
Balsamroot, scab	*B. serrata*
Buckwheat, creamy (Wyeth eriogonum).	*Eriogonum heracleoides*
Buckwheat, Douglas	*E. douglasii*
Buckwheat, heartleaf (northern eriogonum).	*E. compositum*
Buckwheat, snow	*E. niveum*
Buckwheat, wirestemmed (broom eriogonum).	*E. vimineum*
Buttercup, sagebrush	*Ranunculus glaberrimus*
Butterweed	*Senecio* spp.
Chickweed	*Stellaria nitens*
Clarkia	*Clarkia pulchella*
Collomia	*Collomia grandiflora*
Daggerpod (parrya)	*Parrya cheiranthoides*

FORBS—Continued

Local common name	Scientific name
Daisy (fleabane), linearleaf	*Erigeron linearis*
Daisy, shaggy (hairy)	*E. concinnus*
Daisy, threadleaf	*E. filifolius*
Dandelion	*Taraxacum officinale*
Draba, spring	*Draba verna*
Fiddleneck	*Amsinckia intermedia*
Filaree	*Erodium cicutarium*
Fivefingers	*Potentilla* spp.
Hawksbeard, tapertip	*Crepis acuminata*
Indianwheat, woolly	*Plantago purshii*
Kitchenweed	*Gayophytum ramosissimum*
Larkspur, low (slim)	*Delphinium depauperatum*
Loco, speckledpod	*Astragalus lentiginosus*
Loco, woollypod	*A. purshii*
Milkvetch, curvepod	*A. curvicarpus*
Milkvetch, hangingpod	*A. filipes (stenophyllus)*
Milkvetch, hillside	*A. collinus*
Milkvetch, Howell	*A. howellii*
Milkvetch, stiff	*A. conjunctus*
Milkvetch, Tweedy	*A. tweedyi*
Lomatium, barestem	*Lomatium nudicaule*
Lomatium, bigseed (salt-and-pepper).	*L. macrocarpum*
Lomatium, carrotleaf	*L. gormani*
Lomatium, nineleaf	*L. triternatum*
Lupine, silky	*Lupinus sericeus*
Lupine, velvet	*L. leucophyllus*
Tumblemustardweed	*Sisymbrium altissimum*
Onion, tapertip	*Allium acuminatum*
Pepperweed	*Lepidium perfoliatum*
Phlox, longleaf	*Phlox longifolia*
Phlox, spreading	*P. diffusa*
Pussytoes	*Antennaria dimorpha*
Rockcress	*Arabis sparsiflora*
Salsify	*Tragopogon dubius*
Shooting star	*Dodecatheon conjugens*
Snowflake (smallflower woodland-star).	*Lithophragma parviflora*
Stoneseed (wayside gromwell)	*Lithospermum ruderale*
Tarweed	*Madia exigua*
Thistle, bull	*Cirsium lanceolatum*
Yarrow	*Achillea lanulosa*
Yellowbell (yellow fritillary)	*Fritillaria pudica*

SHRUBS

Currant, wax	*Ribes cereum*
Goldenweed	*Aplopappus resinosus*
Horsebrush, gray	*Tetradymia canescens*
Matchweed (snakeweed)	*Gutierrezia sarothrae*
Rabbitbrush, gray (rubber rabbitbrush)	*Chrysothamnus nauseosus* group
Rabbitbrush, green (douglas rabbitbrush).	*C. viscidiflorus* group
Rose	*Rosa pisocarpa*
Sagebrush, big	*Artemisia tridentata*
Sagebrush, scab (stiff)	*A. rigida*
Sagebrush, wormwood (Louisiana)	*A. ludoviciana*
Snowberry	*Symphoricarpos* spp.

TREES

Juniper, western	*Juniperus occidentalis*

Range sites and condition classes

There are 15 different types of range in Sherman County. Each type is called a range site. The sites differ significantly in (1) kinds and amounts of original vegetation, (2) potential yields, and (3) needs for conservation management.

The original plant community, or vegetation, on a range site serves as a standard for judging how the plant community has responded in the past to certain factors, such as grazing, fire, and drought. The composition of the present plant community compared to that of the original is expressed as range condition. There are four range-condition classes.

A range is in *excellent condition* if 75 percent or more of the vegetation is of the same kind as that in the original stand, and if erosion has not occurred or is very slight; it is in *good condition* if the percentage is between 50 and 75 percent, and erosion is no more than slight; it is in *fair condition* if the percentage is between 25 and 50 percent, and erosion is no more than moderate; and it is in *poor condition* if the percentage is less than 25 percent, and erosion is severe.

As the plant community on a range site begins to deteriorate, the more desirable forage plants tend to diminish in the stand, generally at an accelerated rate. Such plants are called *decreasers*. At the same time, the less desirable plants increase. These plants are called *increasers*. If the increasers are palatable forage plants, they, in turn, will be reduced in the stand, and outside plants, generally undesirable ones, will become dominant. Such plants are called *invaders*. These terms are used in the descriptions of the range sites to indicate the behavior of certain key plants both under abuse and under range-recovery programs.

The key forage plants on a range site normally are the most productive plants in the plant community and are the most palatable to livestock. The trend in range condition generally can be judged or predicted on the basis of the degree of use and the vigor of these key plants.

The key forage plant for one range site, however, may not be the key forage plant for a different range site, even though it grows on both. Sometimes, the season of use will determine which plant should be observed in judging response to grazing. Also, the key forage plant on a site commonly grazed by cattle cannot be used to indicate how the same plant community would respond to grazing by sheep.

Bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass are the principal key forage plants on the range sites in Sherman County.

Under normal climatic conditions, forage yields vary according to the degree of deterioration of the range, but yields are also influenced by the vigor of the key forage plants. For example, on the same range site, an area that is in fair condition may, if the forage plants are vigorous, have higher yields than an area in good condition where the forage plants are less vigorous.

Forage yields are not synonymous with herbage yields. Herbage refers to the total yield for the growing season. Forage refers only to that part of the herbage that may, under normal conditions, be removed by grazing without damage to the range.

Range problems and suitable management practices

In Sherman County, the common problems of range management, associated with yearlong livestock operations, are—

1. The need for more and better quality, home-produced summer pasture and winter feed.
2. The need to use native forage plants efficiently to prevent overuse or underuse.
3. The need to observe a safe degree of use on key forage plants in areas that are accessible.

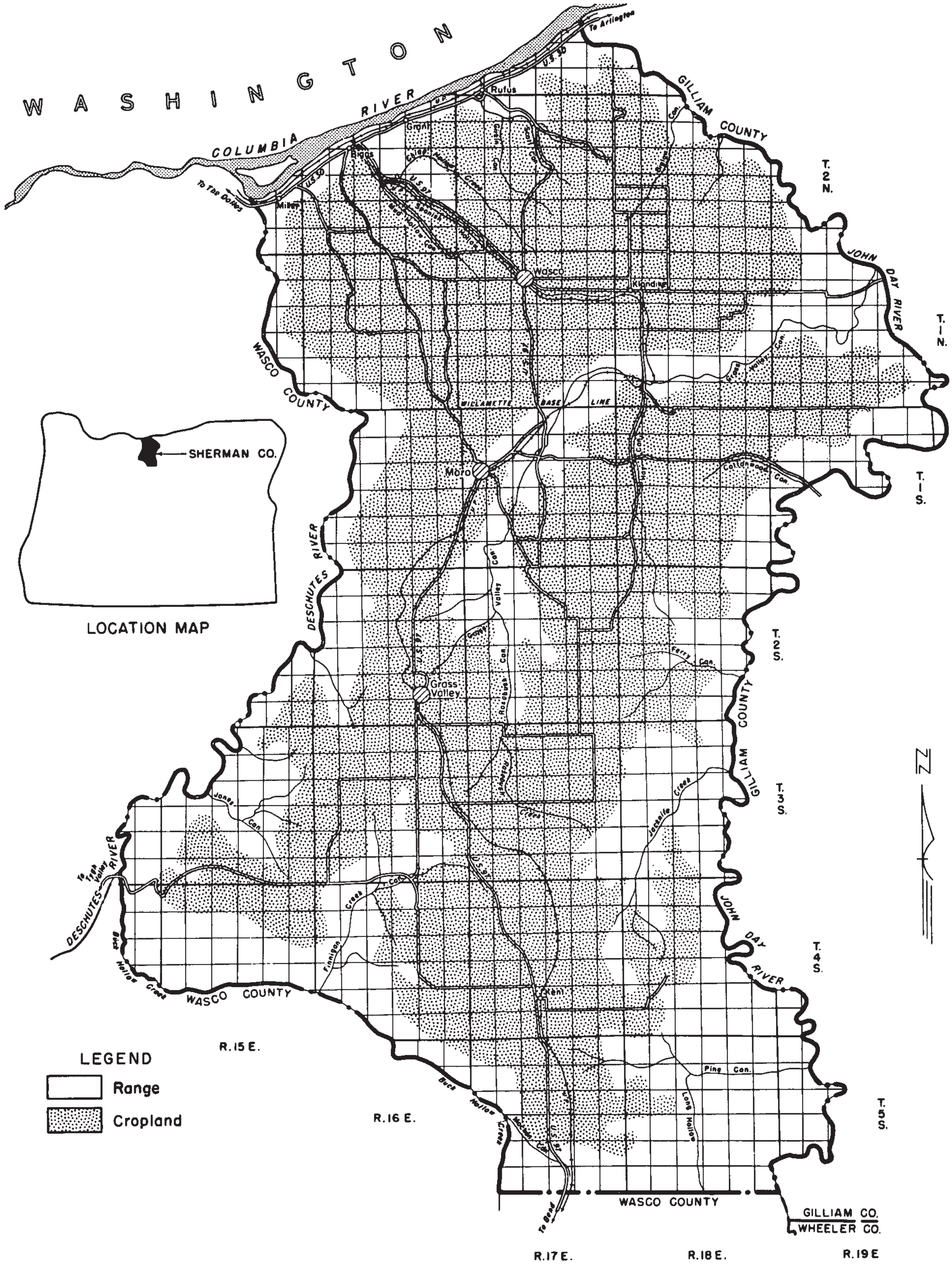

Figure 16.—General range and cropland of Sherman County.

4. The need to determine range readiness.
5. The need to restrict grazing of key forage plants occasionally during the growing season to allow seed to be produced and vigor to be increased.
6. The need, on individual ranches, for range improvement and such development practices as seeding, control of brush and weeds, water development, and fencing.

The object of all range management is to produce the highest quality forage crop that, in turn, can be converted to the greatest net value of animal products per acre, consistent with the conservation of soil, water, and plants.

In Sherman County, a range site that has a vigorous, properly grazed plant community and that is in excellent condition will—

1. Produce the greatest yield of native forage that can be sustained.
2. Produce forage of the highest quality that can be sustained.
3. Produce a stable supply of native forage year after year.
4. Provide an adequate plant cover and enough residues to ensure the stability of the soil, the infiltration of moisture, and the retention of available soil moisture.

A single management practice generally will not completely solve a management problem. A combination of practices is required. For example, seeding an area depleted by overgrazing will not make the area more productive if grazing is not controlled.

Grouping range practices according to their broad purposes helps to clarify their relationship to each other. It also is helpful in deciding which combination of practices is needed to alleviate a specific problem.

Practices that are concerned with the management of forage plants are designed primarily to improve the vigor, proportion, and stand of key forage plants. They include—

1. Safe degree of use.
2. Proper season of use.
3. Range readiness.
4. Deferment of grazing.
5. Rotated deferment of grazing.

Practices that are concerned primarily with the control of livestock movement and with where and how they graze within an area include—

1. Fencing.
2. Development of watering places.
3. Salting in underused areas and away from water.
4. Riding, to prevent excessive bunching, to check the utilization of range sites, and to move animals to good feeding areas.
5. Constructing roads and trails to almost inaccessible areas.
6. Controlling livestock pests.

Practices designed primarily to speed the process of range improvement normally are expensive and difficult. Nevertheless, they can contribute tremendously to the rate at which the native forage can be improved, and they are good investments. They include—

1. Brush control.
2. Seeding.
3. Development of supplemental pasture areas.
4. Development of winter-feed reserves.

Range sites

This subsection describes each of the 15 range sites in Sherman County and names the plants that are dominant if the sites are in excellent condition and those that are most apt to increase or invade if the better grasses are depleted. It also shows the forage yields that can be expected from sites that are in excellent, good, fair, or poor condition, and it discusses general management practices for conservation planning.

Only the principal soils in each range site are named, but most sites include a number of minor soils. The Guide to Mapping Units at the back of the report indicates the range site for each soil in the county. The miscellaneous land types were not placed in the range sites.

DROUGHTY ROLLING HILLS RANGE SITE

This range site occurs mainly on ridgetops and in other gently sloping to rolling areas, but it has a slope range of 2 to 20 percent. It occupies about 5,600 areas, or 2.5 percent of the rangeland in Sherman County. Most of the acreage is in the area of low precipitation in the northern part of the county. There are nine soils in this site. The major ones are—

Condon silt loam, shallow variant, 3 to 15 percent slopes.
Kuhl very rocky very fine sandy loam, 3 to 7 percent slopes.
Ritzville silt loam, moderately deep, 2 to 7 percent slopes.
Starbuck stony silt loam, 4 to 20 percent slopes.
Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes.

The original plant community is about 65 percent bluebunch wheatgrass; 30 percent Sandberg bluegrass; 5 percent or less perennial forbs, such as yarrow, phlox, pussytoes, and woollypod loco; and a small number of such shrubs as big sagebrush, gray rabbitbrush, and matchweed. Idaho fescue does not grow on this site.

If this site begins to deteriorate as a result of grazing by cattle, bluebunch wheatgrass decreases and is replaced by Sandberg bluegrass. If it deteriorates further, such annuals as cheatgrass, Russian-thistle, and fiddleneck invade and shrubs increase. Severe deterioration may eliminate bluebunch wheatgrass and allow Sandberg bluegrass, cheatgrass, annual forbs, and shrubs to become dominant.

If deterioration is due primarily to grazing by sheep, Sandberg bluegrass decreases. If there is severe deterioration, the bluegrass understory is nearly eliminated and the ground is left bare between clumps of bluebunch wheatgrass.

As this site begins to improve from a deteriorated condition, existing forage grasses show signs of increased vigor by producing more and longer leaves and more seedstalks; Sandberg bluegrass becomes established in barren spots; bluebunch wheatgrass becomes established, particularly in cracks in the soil and under the protection of shrubs; and litter accumulates on the surface, especially around the clumps of grass.

Forage yields.—Bluebunch wheatgrass is the major forage plant on this site. Sandberg bluegrass is important for sheep.

The estimated average acre yield of usable air-dried forage is 275 to 400 pounds if the range is in excellent condition; 150 to 350 pounds if the range is in good condition; 75 to 200 pounds if the range is in fair condition; and 25 to 100 pounds if the range is in poor condition.

Safe degree of use.—If this site is grazed by cattle, bluebunch wheatgrass is the key forage plant. A safe degree of use, if this site is grazed during the growing season, is about 50 percent, by weight, of the current year's growth; this leaves a 4- to 6-inch stubble. Removing as much as 70 percent of the current growth, which leaves a 2- to 3-inch stubble, can be done without damage if grazing is deferred through the growing season, year after year, and is permitted only late in fall.

If the site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing in spring and in fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community will be damaged by trampling. Generally, damage by trampling is more pronounced on this site when the soils are excessively dry than when they are wet.

Seeding.—If this site is in poor or just fair condition, it is suitable for seeding to drought-resistant forage plants.

ROLLING HILLS RANGE SITE

This range site occurs mainly on ridgetops and in other gently sloping to undulating areas, but it has a slope range of 1 to 20 percent. It occupies about 9,300 acres, or 4.2 percent of the rangeland in the county. There are 21 soils in this site. The major ones are—

- Condon silt loam, 1 to 7 percent slopes.
- Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes.

The original plant community is about 60 percent bluebunch wheatgrass; 15 percent Sandberg bluegrass; 15 percent Idaho fescue; and 10 percent perennial forbs, such as yarrow, lupine, phlox, daisy, pussytoes, buckwheat, and milkvetch.

If this site begins to deteriorate as a result of grazing by cattle, bluebunch wheatgrass and Idaho fescue decrease and are replaced by Sandberg bluegress. If it deteriorates further, it is invaded by annuals, such as cheatgrass, Pacific fescue, filaree, and tarweed, and by such shrubs as big sagebrush, matchweed, and gray rabbitbrush. Severe deterioration nearly eliminates the forage bunchgrasses and allows Sandberg bluegrass, annuals, and shrubs to become dominant.

If deterioration is due primarily to grazing by sheep, Sandberg bluegrass and Idaho fescue decrease. If there is severe deterioration, the perennial grass understory is nearly eliminated and cheatgrass and shrubs invade.

As this site begins to improve from a deteriorated condition, the existing forage grasses show signs of increased vigor by producing more and longer leaves and more seedstalks; Sandberg bluegrass becomes established in barren spots; bluebunch wheatgrass and, eventually, Idaho fescue become established, particularly under the protection of shrubs; and litter accumulates, especially around clumps of grass, and protects the soil and seedlings.

690-300—64——4

Forage yields.—Bluebunch wheatgrass and Idaho fescue are the major forage plants on this site. Sandberg bluegrass is important for sheep.

The estimated average acre yield of usable air-dried forage is 450 to 700 pounds if the range is in excellent condition; 200 to 600 pounds if the range is in good condition; 75 to 300 pounds if the range is in fair condition; and 50 to 100 pounds if the range is in poor condition.

Safe degree of use.—If this site is grazed by cattle, bluebunch wheatgrass is the key forage plant. A safe degree of use, if this site is grazed during the growing season, is about 50 percent, by weight, of the current year's growth; this amount of grazing leaves a 4- to 6-inch stubble. Removing as much as 70 percent of the current growth, which leaves a 2- to 3-inch stubble, can be practiced without damage if grazing is deferred through the growing season and is permitted only late in fall.

If the site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing in spring and fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community will be damaged by trampling.

Seeding.—If this site is in poor or just fair condition, it is well suited to the seeding of forage plants.

SCABLAND RANGE SITE

There is only one soil in this range site, Bakeoven very stony loam, 2 to 20 percent slopes. This site occurs along the outer edge of ridgetops and in sloping areas along small drainageways. It occupies about 6,000 acres, or 2.7 percent of the rangeland in Sherman County.

The original plant community is about 85 percent Sandberg bluegrass; less than 5 percent bluebunch wheatgrass; about 10 percent perennial forbs, such as daisy, phlox, pussytoes, buckwheat, and carrot; and in some places as much as 5 percent scab sagebrush.

If this site deteriorates, the already sparse stand of bluebunch wheatgrass is eliminated, Sandberg bluegrass decreases, and scab sagebrush and forbs increase. Few perennial plants invade, because their growth is restricted by the shallowness of the soil.

Because of the low foliage and the short season for Sandberg bluegrass, this site generally is not grazed enough by cattle to cause it to deteriorate below good condition. If it is grazed by cattle in winter and by sheep late in fall, in winter, and in spring, the Sandberg bluegrass is nearly eliminated and, except for some scab sagebrush, most of the ground is left bare.

As this site improves from a deteriorated condition, Sandberg bluegrass becomes established in bare areas, particularly under shrubs.

Forage yields.—Sandberg bluegrass is the principal forage plant. For the short time in spring or late in fall during which this site can be grazed, the estimated average acre yield of usable air-dried forage is 60 to 100 pounds if the range is in excellent condition; 30 to 75 pounds if the range is in good condition; 25 to 40 pounds if the range is in fair condition; and 10 to 30 pounds if the range is in poor condition.

If this site is grazed by cattle, the forage produced is so limited in amount and is available for such a short time that it should not be considered in estimating the supply within a pasture. This site should not be used as a basis for determining degree of use, range readiness, or season of use.

Water development.—Areas along small drainageways can be used as sites for ponds to provide seasonal water for livestock.

DROUGHTY BISCUIT-SCABLAND COMPLEX

This complex consists of areas of both the Droughty Rolling Hills and the Scabland range sites. It occupies about 8,800 acres, or 4.0 percent of the rangeland in the county, and occurs on ridgetops and in other sloping areas. It is represented by only one mapping unit, Starbuck-Bakeoven complex, 2 to 20 percent slopes.

The Starbuck soil occurs as circular or elongated mounds, or biscuits, and makes up from 15 to 85 percent of this complex of range sites. The Bakeoven soil occurs as scabland between and around the mounds. (If less than 15 percent of an area is Starbuck soil, the area is included in the Scabland range site. If more than 85 percent is Starbuck soil, the area is included in the Droughty Rolling Hills range site.)

The original plant community on the Starbuck soil is the same as that for the Droughty Rolling Hills range site, and the response to grazing is the same. The original plant community on the Bakeoven soil is the same as that for the Scabland range site.

Forage yields.—To estimate forage yields for this complex, first determine the yields produced on the Starbuck soil by referring to the description of the Droughty Rolling Hills range site, then adjust this figure downward according to the percentage of Starbuck soil in the area. Generally, it is not practical to consider forage yields on the Bakeoven soil in this complex, because the season of use is markedly different from that of the Starbuck soil, and yields of forage are lower.

Range readiness, safe degree of use, and other forage management practices for this complex should be determined on the basis suggested for the Droughty Rolling Hills range site.

Generally, the biscuit areas have deteriorated more than the adjacent scabland, particularly if they have been grazed by cattle. This is partly due to the fact that palatable forage grows for a much longer period on the biscuits. Consequently, under season-long grazing, the biscuits are grazed more heavily. Also, snow is blown more readily from the biscuits, and the vegetation is exposed for concentrated winter grazing.

Seeding.—Generally, it is as practical to seed the biscuits on this complex as it is to seed the soils in the Droughty Rolling Hills range site, but stones and boulders on the scabland commonly interfere with the use of equipment. To ascertain the cost and benefit of seeding, it is necessary to determine the proportion of Starbuck soil in the total area, because only the Starbuck soil responds to seeding.

BISCUIT-SCABLAND COMPLEX

This complex consists of areas of both the Rolling Hills and the Scabland range sites. It occupies about 45,500 acres, or 20.4 percent of the rangeland in the county, and is the largest range site in the county. It is represented by only one soil mapping unit, Condon-Bakeoven complex, 2 to 20 percent slopes.

The Condon soil occurs as circular or elongated mounds, or biscuits, and makes up from 15 to 85 percent of this complex of range sites. The Bakeoven soil occurs as scabland between and around the mounds. (If less than 15 percent of an area is Condon soil, the area is included in the Scabland range site. If more than 85 percent is Condon soil, the area is included in the Rolling Hills range site.)

The original plant community on the Condon soil is the same as that for the Rolling Hills range site, and the response to grazing is the same. The original plant community on the Bakeoven soil is the same as that for the Scabland range site.

Forage yields.—To estimate forage yields for this complex, first determine the yields produced on the Condon soil by referring to the description of the Rolling Hills range site, then adjust this figure downward according to the percentage of Condon soil in the area. Generally, it is not practical to consider forage yields on the Bakeoven soil in this complex, because the season of use is different from that of the Condon soil and yields of forage are lower.

Range readiness, safe degree of use, and other forage management practices for this site should be determined on the basis of those suggested for the Rolling Hills range site.

Generally, the biscuit areas have deteriorated more than the adjacent scabland, particularly if the site is grazed by cattle. This is partly due to the fact that the season for palatable forage is much longer on the biscuits. Consequently, under season-long grazing, the forage on the biscuits is grazed more heavily. Also, snow is blown more readily from the biscuits, and the vegetation is exposed for concentrated winter grazing.

Seeding.—Generally, it is as practical to seed the biscuits on this complex as it is to seed the soils in the Rolling Hills range site, but stones and boulders on the scabland commonly interfere with the use of equipment. To ascertain the cost and benefit of seeding, it is necessary to determine the proportion of Condon soil in the total area, because only the Condon soil responds to seeding.

MODERATE SOUTH EXPOSURE RANGE SITE

This site occurs along drainageways, mostly in sloping to moderately steep areas. It consists of about 16,700 acres, or 7.5 percent of the rangeland in the county. The slope range is from 7 to 40 percent; the exposure is toward the south, the southeast, and the west. There are seven mapping units in this site, the major ones of which are—

Lickskillet very stony loam, 7 to 40 percent south slopes.
Starbuck very stony silt loam, 7 to 40 percent south slopes.

The original plant community is about 70 percent bluebunch wheatgrass; 20 percent Sandberg bluegrass; 10 percent perennial forbs, such as buckwheat, yarrow, arrowleaf balsamroot, daisy, phlox, and pussytoes; and a small amount of such shrubs as big sagebrush, matchweed, and gray rabbitbrush. Idaho fescue does not grow on this site.

If this site begins to deteriorate as a result of grazing by cattle, bluebunch wheatgrass decreases and is replaced by Sandberg bluegrass. If it deteriorates further, such annuals as cheatgrass, fiddleneck, thistle, and filaree invade, and perennial forbs and shrubs increase. Severe deterioration may eliminate bluebunch wheatgrass and allow annuals, forbs of low forage value, and shrubs to become dominant. Scab sagebrush and scab balsamroot invade areas that are severely eroded if the subsoil in these areas is moderately fine textured or clayey.

If deterioration is due primarily to grazing by sheep, Sandberg bluegrass decreases. If there is severe deterioration, the understory of Sandberg bluegrass and forbs is nearly eliminated, and the ground is left bare between clumps of bluebunch wheatgrass.

As this site begins to improve from a deteriorated condition, existing bunchgrasses show signs of increased vigor by producing more and longer leaves and more seedstalks; Sandberg bluegrass becomes established in barren spots; bluebunch wheatgrass becomes established, particularly under shrubs; and litter accumulates on the surface, especially around the clumps of grass.

If this site and the Steep South Exposure range site occur together in a pasture, this less strongly sloping site is grazed more readily by livestock and, consequently, will deteriorate more rapidly and recover more slowly. If both sites are subjected to the same kind and intensity of grazing, however, this site will deteriorate more slowly and recover more rapidly because, normally, erosion is less severe.

Forage yields.—Bluebunch wheatgrass is the major forage plant on this site. Sandberg bluegrass is important for sheep.

The estimated average acre yield of usable air-dried forage is 300 to 500 pounds if the range is in excellent condition; 125 to 375 pounds if the range is in good condition; 50 to 175 pounds if the range is in fair condition; and 40 to 75 pounds if the range is in poor condition.

Safe degree of use.—If this site is grazed by cattle, bluebunch wheatgrass is the key forage plant. A safe degree of use, if the site is grazed during the growing season, is about 50 percent, by weight, of the current year's growth; this degree of use leaves a 4- to 6-inch stubble. Removing as much as 70 percent of the current growth, which leaves a 2- to 3-inch stubble, can be done without damage if grazing is deferred for the full growing season and is permitted only in fall.

If the site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing in spring and in fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community will be damaged by trampling.

Fencing.—In many places, this site occurs as areas large enough to form practical grazing units, or it is adjacent to other south-facing sites that can be combined with it to form grazing units. These units should be fenced off from sites that have a later season of use.

STEEP SOUTH EXPOSURE RANGE SITE

This range site occurs along drainageways in steep to very steep areas. It occupies about 39,500 acres, or 17.8 percent of the rangeland in the county. The slope range is from 40 to 70 percent; the exposure is toward the south, southeast, and west. The two soils in this site are—

Lickskillet extremely stony loam, 40 to 70 percent south slopes.
Starbuck extremely stony silt loam, 40 to 70 percent south slopes.

The original plant community is about 70 percent bluebunch wheatgrass; 20 percent Sandberg bluegrass; 10 percent perennial forbs, such as buckwheat, yarrow, arrowleaf balsamroot, daisy, phlox, and pussytoes; and small amounts of such shrubs as big sagebrush, gray rabbitbrush, and matchweed. Idaho fescue does not grow on this site.

If this site begins to deteriorate as a result of grazing by cattle, bluebunch wheatgrass decreases and is replaced by Sandberg bluegrass. If it deteriorates further, such annuals as cheatgrass, fiddleneck, thistle, and filaree invade, and shrubs and perennial forbs increase. Severe deterioration may eliminate bluebunch wheatgrass and allow annuals, forbs of low forage value, and shrubs to become dominant. Scab sagebrush and scab balsamroot will invade areas that are severely eroded if the subsoil in these areas is moderately fine textured or fine textured.

If deterioration is due primarily to grazing by sheep, Sandberg bluegrass decreases. If there is severe deterioration, the understory of Sandberg bluegrass and forbs is nearly eliminated and the ground is left bare between clumps of bluebunch wheatgrass.

As this site begins to improve from a deteriorated condition, existing forage bunchgrasses show signs of increased vigor by producing more and longer leaves and more seedstalks; Sandberg bluegrass becomes established in barren spots; bluebunch wheatgrass becomes established, particularly under shrubs; and litter accumulates especially around clumps of grass.

If this site and the Moderate South Exposure range site occur together in a pasture, this steeper site is grazed less readily by livestock and, consequently, deteriorates more slowly and recovers more rapidly. If both sites are subjected to the same kind and intensity of grazing, however, this steeper site will deteriorate more rapidly because, normally, erosion is more severe.

Forage yields.—Bluebunch wheatgrass is the major forage plant on this site. Sandberg bluegrass is important for sheep.

The estimated average acre yield of usable air-dried forage is 275 to 500 pounds if the range is in excellent condition; 150 to 325 pounds if the range is in good condition; 75 to 175 pounds if the range is in fair condition; and 40 to 75 pounds if the range is in poor condition.

If this site and a significant acreage of less strongly sloping sites occur together in a pasture, the estimated forage yields on this steep site should be adjusted downward. Otherwise, the stocking rate will be too high, and the less strongly sloping sites will be overgrazed before the forage on this site is used. In a pasture used only for summer grazing, the potential forage yields on this site should not be included in the determination of yield for the entire pasture. Livestock will make little or no use of the forage on this steep site during hot, dry weather.

Safe degree of use.—If this site is grazed by cattle, bluebunch wheatgrass is the key forage plant. A safe degree of use is about 50 percent, by weight, of the current year's growth, leaving a 4- to 6-inch stubble.

If this site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing in spring and in fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community will be damaged by trampling.

Fencing.—In many places, this site occurs as areas large enough to form practical grazing units, or it is adjacent to other south-facing sites that can be combined with it to form units. These units should be fenced off from sites that have a later season of use.

DROUGHTY NORTH EXPOSURE RANGE SITE

This range site occurs on moderately steep areas along drainageways. It occupies about 11,300 acres, or 5.1 percent of the rangeland in the county. The slope range is from 7 to 35 percent. Exposure is toward the north, northwest, and northeast. There are nineteen soils in this site, the major ones of which are—

Condon silt loam, 7 to 20 percent north slopes.
Condon silt loam, 20 to 35 percent north slopes.
Kuhl stony silt loam, 10 to 35 percent north slopes.
Kuhl very stony very fine sandy loam, 7 to 35 percent north slopes.
Ritzville silt loam, moderately deep, 20 to 35 percent north slopes.

The original plant community is about 40 percent bluebunch wheatgrass; 35 percent Idaho fescue; 15 percent Sandberg bluegrass; and 10 percent perennial forbs, such as yarrow, pussytoes, phlox, lupine, milkvetch, daisy, and buckwheat.

If this site begins to deteriorate as a result of grazing by cattle, both Idaho fescue and bluebunch wheatgrass decrease and are replaced by Sandberg bluegrass. If it deteriorates further, the perennial forbs increase, and annuals and such shrubs as gray rabbitbrush, green rabbitbrush, matchweed, and big sagebrush invade.

If deterioration is due primarily to grazing by sheep, both Idaho fescue and Sandberg bluegrass decrease and are replaced by shrubs and annuals. Rabbitbrush, big sagebrush, cheatgrass, and annual forbs are strong invaders if the site is severely deteriorated.

As this site begins to improve from a deteriorated condition, forage bunchgrasses become established; cheatgrass is reduced; the existing forage bunchgrasses show signs of increased vigor by producing more and longer leaves and more seedstalks; and litter accumulates on the surface.

Forage yields.—Bluebunch wheatgrass and Idaho fescue are the major forage plants on this site.

The estimated average acre yield of usable air-dried forage is 400 to 750 pounds if the range is in excellent condition; 200 to 650 pounds if the range is in good condition; 75 to 350 pounds if the range is in fair condition; and 40 to 150 pounds if the range is in poor condition.

Safe degree of use.—If this site is grazed by cattle, the key forage plant is bluebunch wheatgrass. A safe degree of use, if this site is grazed during the growing season, is about 50 percent, by weight, of the current year's growth; this grazing leaves a 4- to 6-inch stubble. Removing as much as 70 percent of the current growth, so as to leave a 2- to 3-inch stubble, can be done without damage if grazing is deferred through the growing season and is permitted only in fall.

If this site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing late in spring, early in summer, and in fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community is damaged by trampling.

Fencing.—In many places, this site is adjacent to other north-facing sites that can be combined with it to form practical grazing units. These units should be fenced off from sites that have an earlier season of use.

DROUGHTY STEEP NORTH EXPOSURE RANGE SITE

There is only one soil in this range site, Lickskillet extremely stony loam, 40 to 70 percent north slopes. This site occurs along drainageways in steep to very steep areas. It occupies about 1,340 acres, or 0.6 percent of the rangeland in the county. The exposure is toward the north, northwest, and northeast.

The original plant community is about 80 percent Idaho fescue; 10 percent Sandberg bluegrass; 5 percent bluebunch wheatgrass; and 5 percent perennial forbs, such as yarrow, lupine, phlox, milkvetch, and daisy.

If this site begins to deteriorate as a result of grazing by cattle, Idaho fescue decreases and is replaced by Sandberg bluegrass and bluebunch wheatgrass. If it deteriorfurther, it is invaded by such annuals as cheatgrass, filaree, tarweed, and tumblemustard, and by such shrubs as gray rabbitbrush, big sagebrush, and matchweed. Severe deterioration allows cheatgrass, annual forbs, and shrubs to become dominant.

If deterioration is due primarily to grazing by sheep, Sandberg bluegrass and Idaho fescue decrease and are replaced by cheatgrass, annual forbs, and shrubs.

As this site begins to improve from a deteriorated condition, bunchgrasses become established; cheatgrass is reduced; existing forage bunchgrasses show signs of increased vigor by producing more and longer leaves and more seedstalks; and litter accumulates on the surface.

Forage yields.—Bluebunch wheatgrass and Idaho fescue are the major forage plants on this site.

The estimated average acre yield of usable air-dried forage is 350 to 600 pounds if the range is in excellent condition; 225 to 500 pounds if the range is in good condition; 100 to 300 pounds if the range is in fair condition; and 40 to 150 pounds if the range is in poor condition.

If this steep site and a significant acreage of other less strongly sloping sites occur together in a pasture, the estimated forage yields on this site should be adjusted downward. Otherwise, the stocking rate will be too high, and the less strongly sloping sites will be overgrazed before the forage on this site is used.

Safe degree of use.—If this site is grazed by cattle, bluebunch wheatgrass is the key forage plant. A safe degree of use is about 50 percent, by weight, of the current year's growth, which leaves a 4- to 6-inch stubble.

If this site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing late in spring, early in summer, and in fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community will be damaged by trampling.

Fencing.—In many places, this site is adjacent to other north-facing sites that can be combined with it to form practical grazing units. These units should be fenced off from sites that have an earlier season of use.

MODERATE NORTH EXPOSURE RANGE SITE

This range site occurs along drainageways in moderately steep areas. It occupies about 3,300 acres, or 1.5 percent of the rangeland of the county. The slope range is from 20 to 35 percent; the exposure is toward the north, northwest, and northeast. There are seven soils in this range site. The major ones are—

Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes.
Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes.
Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes.

The original plant community is about 60 percent Idaho fescue; 25 percent bluebunch wheatgrass; 10 percent Sandberg bluegrass; and 5 percent perennial forbs, such as yarrow, lupine, phlox, and milkvetch.

If this site begins to deteriorate as a result of grazing by cattle, Idaho fescue decreases and is replaced by bluebunch wheatgrass and Sandberg bluegrass. If it further deteriorates, bluebunch wheatgrass decreases and is replaced by Sandberg bluegrass, annuals, and such shrubs as big sagebrush, gray rabbitbrush, green rabbitbrush, matchweed, and gray horsebrush.

If deterioration is due primarily to grazing by sheep, Idaho fescue and Sandberg bluegrass decrease and are replaced by bluebunch wheatgrass and annuals. If there is severe deterioration, cheatgrass, annual forbs, and shrubs invade.

As this site begins to improve from a deteriorated condition, bluebunch wheatgrass shows signs of increased vigor; major forage grasses become established; litter accumulates and protects the soil and seedlings.

Forage yields.—Idaho fescue and bluebunch wheatgrass are the major forage plants on this site.

The estimated average acre yield of usable air-dried forage is 450 to 800 pounds if the range is in excellent condition; 350 to 800 pounds if the range is in good condition; 150 to 600 pounds if the range is in fair condition; and 100 to 300 pounds if the range is in poor condition.

In the early stages of deterioration of this site, bluebunch wheatgrass, if vigorous, temporarily replaces Idaho fescue, and forage yields remain about the same. This change in the plant community, however, reduces the value of the site for summer grazing because Idaho fescue is better for summer forage.

Safe degree of use.—The key forage plant on this site for all livestock is Idaho fescue. A safe degree of use, if this site is grazed during the growing season, is about 40 percent, by weight, of the current year's growth; this degree of use leaves a 2- to 3-inch stubble. Removing as much as 50 to 60 percent of the current growth, so as to leave a 1- to 1.5-inch stubble, will not cause damage if grazing is deferred through the full growing season and is permitted only in fall.

Season of use.—This site is best suited to grazing late in spring, in summer, and in fall.

Range readiness.—Because of its late season of use, this site should not be used as a basis for determining when livestock should be allowed to graze the range in spring.

Fencing.—In many places, this site occurs as areas large enough to form practical grazing units, or it is adjacent to other north-facing sites that can be combined with it to form units. These units should be fenced off from sites that have an earlier season of use.

STEEP NORTH EXPOSURE RANGE SITE

This range site occurs along drainageways in steep to very steep areas. It occupies about 39,500 acres, or 17.8 percent of the rangeland in the county. The slope range is from 35 to 70 percent; the exposure is nearly due north. There are only two soils in this site—

Nansene rocky silt loam, 35 to 70 percent slopes.
Wrentham rocky silt loam, 35 to 70 percent slopes.

The original plant community is about 80 percent Idaho fescue; 10 percent Sandberg bluegrass; 5 percent bluebunch wheatgrass; and 5 percent perennial forbs, such as yarrow, lupine, phlox, milkvetch, and daisy.

If this site begins to deteriorate as a result of grazing by cattle, Idaho fescue decreases and is replaced by Sandberg bluegrass and bluebunch wheatgrass. If it deteriorates further, bluebunch wheatgrass decreases and is replaced by Sandberg bluegrass; annuals; forbs, such as velvet lupine, milkvetch, yarrow, and buckwheat; and some shrubs, such as big sagebrush, green rabbitbrush, gray rabbitbrush, and matchweed.

If deterioration results primarily from grazing by sheep, Idaho fescue and Sandberg bluegrass decrease and are temporarily replaced by bluebunch wheatgrass. If there is further deterioration, cheatgrass, annual forbs, and shrubs invade.

As this site begins to improve from a deteriorated condition, bluebunch wheatgrass shows signs of increased vigor; the major forage grasses become established; and litter accumulates on the surface and protects seedlings.

Forage yields.—Idaho fescue is the major forage plant on this site.

The estimated average acre yield of usable air-dried forage is 400 to 750 pounds if the range is in excellent condition; 300 to 800 pounds if the range is in good condition; 150 to 600 pounds if the range is in fair condition; and 100 to 350 pounds if the range is in poor condition.

In the early stages of deterioration of this site, bluebunch wheatgrass, if vigorous, temporarily replaces Idaho fescue, and forage yields remain about the same or even increase slightly. This change in the plant community, however, reduces the value of the site for summer grazing because Idaho fescue is better for summer forage.

If this site and a significant acreage of other less strongly sloping sites occur together in a pasture, the estimated forage yields on this steep site should be adjusted downward. Otherwise, the stocking rate will be too high, and the less strongly sloping sites will be overgrazed before the forage on this steep site is used.

Safe degree of use.—The key forage plant on this site for all kinds of livestock is Idaho fescue. A safe degree of use, if this site is grazed during the growing season, is about 40 percent, by weight, of the current year's growth; this degree of use leaves a 2- to 3-inch stubble. Removing as much as 50 to 60 percent of the current growth, so as to leave a 1- to 1.5-inch stubble, does not damage the range if grazing is deferred through the growing season and is permitted only in fall.

Season of use.—This site is best suited to grazing late in spring, in summer, and in fall.

Range readiness.—Because of its late season of use, this site should not be used as a basis for determining when livestock should be allowed to graze the range in spring.

Fencing.—In many places, this site occurs as areas large enough to form practical grazing units, or it is adjacent to other north-facing sites that can be combined with it to form units. These units should be fenced off from sites that have an earlier season of use.

SILTY TERRACE RANGE SITE

There is only one soil in this range site, Sagemoor silt loam, 5 to 40 percent slopes. This site occurs in small areas at elevations of 600 to 1,000 feet on remnants of an old calcareous lake terrace along both the Deschutes and John Day Rivers. It occupies about 3,800 acres, or 1.7 percent of the rangeland in the county.

The original plant community is about 60 percent bluebunch wheatgrass; 30 percent Sandberg bluegrass; a small amount of needle-and-thread; 5 percent perennial forbs, such as yarrow, daisy, pussytoes, and phlox; and a small amount of such shrubs as big sagebrush and matchweed. Idaho fescue does not grow on this site.

If this site begins to deteriorate as a result of grazing by cattle, bluebunch wheatgrass decreases and is replaced by Sandberg bluegrass. If it deteriorates further, needle-and-thread, matchweed, and big sagebrush increase, and such annuals as cheatgrass and filaree invade. Severe deterioration may eliminate the bluebunch wheatgrass and allow Sandberg bluegrass, cheatgrass, matchweed, and big sagebrush to become dominant. Big sagebrush will not grow where wildfires have occurred.

If deterioration results primarily from grazing by sheep, Sandberg bluegrass decreases. If there is severe deterioration, the bluegrass understory is nearly eliminated and cheatgrass occupies the space between large clumps of bluebunch wheatgrass.

As this site begins to improve from a deteriorated condition, existing forage grasses show signs of increased vigor by producing more and longer leaves and more seedstalks; Sandberg bluegrass becomes established in barren spots; bluebunch wheatgrass becomes established, particularly under the protection of shrubs; and litter accumulates on the surface, especially around clumps of grass.

Forage yields.—Bluebunch wheatgrass is the major forage plant on this site. Sandberg bluegrass is important for sheep.

The estimated average acre yield of usable air-dried forage is 250 to 350 pounds if the range is in excellent condition; 150 to 300 pounds if the range is in good condition; 75 to 175 pounds if the range is in fair condition; and 25 to 100 pounds if the range is in poor condition.

Safe degree of use.—If this site is grazed by cattle, bluebunch wheatgrass is the key forage plant. A safe degree of use, if this site is grazed during the growing season, is about 50 percent, by weight, of the current year's growth, so as to leave a 4- to 6-inch stubble. Removing as much as 70 percent of the current growth, so as to leave a 2- to 3-inch stubble, does not damage the range if grazing is deferred through the growing season, year after year, and is permitted only late in fall.

If this site is grazed by sheep, Sandberg bluegrass is the key forage plant. Spring grazing should be terminated early enough to allow the formation of seedstalks.

Season of use.—This site is best suited to grazing in spring and in fall.

Range readiness.—This site is ready for grazing when bluebunch wheatgrass has 6 to 8 inches of new leaf growth and the soil is in such condition that neither it nor the plant community will be damaged by trampling.

Seeding.—If this site is in poor or just fair condition, it is suitable for seeding to drought-resistant forage plants.

WELL-DRAINED BOTTOM RANGE SITE

This range site occurs as small, narrow areas along streams. It occupies about 4,500 acres, or 2.0 percent of the rangeland in the county. The slope range is from 0 to 5 percent. There are only two soils in this site—

Hermiston loam, 0 to 5 percent slopes.
Sandy alluvial land.

A dense stand of giant wildrye makes up about 70 percent of the plant community. Perennial forbs, such as fivefingers, geranium, lupine, avens, yarrow, and butterweed, make up about 5 percent. The understory contains such perennial grasses as big bluegrass, Kentucky bluegrass, slender wheatgrass, dry-meadow sedge, Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. Such shrubs as green rabbitbrush, rose, snowberry, and wormwood sagebrush occur in small amounts.

If this site begins to deteriorate, the understory of forage grasses decreases and is replaced by perennial forbs and shrubs. If it deteriorates further, such annuals as cheatgrass, soft chess, tarweed, tumblemustard, and china lettuce invade. If there is severe deterioration, giant wildrye is replaced by shrubs, annual grasses, and both annual and perennial forbs.

As this site begins to improve from a deteriorated condition, giant wildrye shows signs of increased vigor by producing more and longer leaves, more seedstalks, and larger clumps; and some annuals are replaced by perennial forbs. As giant wildrye becomes reestablished in the stand, it replaces some of the perennial forbs. Once deep-rooted shrubs are established, however, they will persist unless killed by chemicals or other means.

Forage yields.—Giant wildrye is the major forage plant on this site.

The estimated average acre yield of usable air-dried forage is 2,500 to 4,000 pounds if the range is in excellent condition; 1,700 to 3,500 pounds if the range is in good condition; 400 to 2,500 pounds if the range is in fair condition; and 100 to 800 pounds if the range is in poor condition.

Safe degree of use.—If this site is grazed by cattle or horses during the growing season and before seedheads form, an 8- to 10-inch stubble of giant wildrye should be left. If it is grazed only late in fall, a 6- to 8-inch stubble of giant wildrye should be left.

Some areas are too small to be fenced off and are used with upland sites for grazing in spring and in summer.

These should be considered sacrifice areas because generally they are close to water for livestock. A safe degree of use should be determined only for the upland sites.

Season of use.—This site is best suited to grazing in summer and in fall.

Range readiness.—This site is ready for grazing when giant wildrye has 24 to 30 inches of new leaf growth. It should not be used to determine when livestock should be permitted to graze the range in spring.

Seeding.—The seeding of forage plants for summer and fall grazing is practical if the areas are severely depleted and are large enough to make up a grazing unit.

SAND HILLS RANGE SITE

This range site consists of only one soil, Quincy loamy fine sand, 0 to 20 percent slopes. It occurs along the Columbia River and occupies only about 690 acres, or 0.3 percent of the rangeland in the county.

The original plant community consists of bluebunch wheatgrass, needlegrass, Indian ricegrass, and Sandberg bluegrass. If this site begins to deteriorate, bluebunch wheatgrass and Indian ricegrass are replaced by needlegrass.

The management practices for this site are similar to those for the Droughty Rolling Hills range site, but forage yields average about 25 percent less for each range-condition class. When the soil is dry, this site is especially susceptible to damage by trampling. If severely deteriorated, it may be damaged by wind.

ALKALINE BOTTOM RANGE SITE

This range site occurs along a few streams in the southern part of the county. It occupies only about 33 acres and is represented by only one soil, Pedigo silt loam. The slope range is from 0 to 2 percent.

The original plant community consists of giant wildrye and saltgrass. If the site deteriorates, giant wildrye decreases and saltgrass increases. Forage yields are similar to those on the Well-Drained Bottom range site.

Engineering Data and Interpretations [3]

Soil surveys are commonly being used in engineering work, especially in highway and dam construction and in watershed planning. A knowledge of the physical properties of soils is needed to predict the behavior of soils in engineering as well as in agriculture. Determining the engineering properties of different soil types by laboratory tests can reduce the need for more costly and time-consuming tests at new or proposed sites for engineering structures.

The information in this report can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils that are significant in planning agricultural drainage and irrigation systems, farm ponds, and terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soils and thus gain information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be readily used by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

This report does not eliminate the need for sampling and testing soils at the site chosen for construction. The mapping and the descriptions of the soils are somewhat generalized and, therefore, are not a substitute for detailed engineering surveys at a particular site.

Some terms used by the agricultural soil scientist may be unfamiliar to the engineer, and some terms may have a special meaning in soil science. These terms are defined in the Glossary at the end of this report.

Engineering soil classification and test data

Two systems are used to classify soils according to their engineering properties, that of the American Association of State Highway Officials, the AASHO system (*1*),[4] and that developed by the Corps of Engineers, U.S. Army, the Unified system (*16*).

The AASHO system is used by engineers to classify soils according to their engineering properties as determined by the performance of soils in highways. In this system, the soils are grouped according to their highway subgrade strength and service into seven basic groups designated A–1 through A–7. The best soils for road subgrades are classified as A–1, and the poorest as A–7. Within each group, the relative engineering value of the soil material may be indicated by a group index number. The group index number is shown in parentheses following the soil group symbol. Group indexes range from 0 for the best material to 20 for the poorest.

In the Unified classification, the soils are grouped on the basis of their texture and plasticity and their performance as material for engineering structures. Coarse-grained soils are those that have 50 percent or less of material passing the No. 200 sieve; fine-grained soils are those that have more than 50 percent of material passing the No. 200 sieve. The soil materials are identified as coarse grained, which are gravels (G) and sands (S); fine grained, which are silts (M) and clays (C); and highly organic (Pt). In this system, SW and SP are clean sands; SM and SC are sands that include fines of silt and clay; ML and CL are silts and clays that have a low liquid limit; and MH and CH are silts and clays that have a high liquid limit.

Table 4 gives engineering test data for soil samples taken from 12 soil profiles. The tests were performed by the Oregon State University and the Bureau of Public Roads

[3] R. W. MAYKO, Soil Conservation Service, assisted in preparing this section.

[4] Italic numbers in parentheses refer to Literature Cited, p. 102.

TABLE 4.—*Engineering test data for*

[Tests performed in accordance with standard procedures of the American Association of State Highway Officials (AASHO). Tests on by the Bureau of Public Roads. Tests on the Walla Walla soils from Sherman County, Oreg., performed by the Oregon State

Soil name and location	Parent material	Report number	Depth from surface (typical profile)	Horizon	Moisture-density [1]		Mechanical analysis [2]			
					Maximum dry density	Optimum moisture	Estimated percentage larger than 3 in. discarded in field sampling	Percentage passing sieve—		
								2 in.	1½ in.	1 in.
			Inches		*Lb. per cu. ft.*	*Percent*				
Lickskillet very stony loam: NW¼NE¼NW¼ sec. 9, T. 4 S., R. 18 E.	Mixed loess and basalt rock.	S32461	0 to 5	A1	113	15			100	99
		S32462	9 to 20	B2	109	18		100	99	97
Lickskillet extremely stony loam: NE¼SW¼NW¼ sec. 6, T. 4 S., R. 15 E.	Mixed loess and basalt rock.	S32463	0 to 4	A1	122	13	7	93	92	91
		S32464	9 to 14	B21	113	17	7	93	93	92
Ritzville silt loam: NW¼NW¼ sec. 1, T. 7 N., R. 34 E.	Loess over stratified lake-laid material.	92704	0 to 7	A	110	15				
		92705	7 to 13	B	110	15				
		92706	31 to 48	C	112	16				
		92707	48+	D	113	16				
Ritzville silt loam: SW¼SW¼ sec. 35, T. 9 N., R. 34 E.	Loess	92708	0 to 8	A	106	16				
		92709	8 to 32	B	107	16				
		92710	48 to 60	C	110	16				
Ritzville silt loam: NE¼NE¼ sec. 35, T. 10 N., R. 33 E.	Loess	92711	0 to 9	A	103	16				
		92712	9 to 37	B	103	18				
		92713	50 to 65	C	106	16				
Sagemoor very fine sandy loam: SW. cor. NE¼SW¼ sec. 31, T. 7 N., R. 33 E.	Shallow loess over lake-laid material.	92714	0 to 12	A	109	15				
		92715	12 to 24	B	109	15				
		92716	32 to 60	C	108	17				
Walla Walla very fine sandy loam: NW¼NW¼SW¼ sec. 12, T. 2 N., R. 16 E.	Loess	240–4	0 to 7	Ap	107	16				
		240–5	13 to 22	B21	111	15				
		240–6	33 to 40	C	113	14				100
SW¼SW¼NE¼ sec. 26, T. 3 N., R. 17 E.	Loess	240–19	0 to 6	Ap	107	14				
		240–20	6 to 23	B2	108	15				
		240–21	23 to 39	C	106	16				
Walla Walla silt loam, coarse solum: NW¼NW¼ sec. 22, T. 2 N., R. 17 E.	Loess	240–10	0 to 8	Ap	108	14				
		240–11	18 to 32	B21	111	14				
		240–12	49 to 63	Ccal	103	16				
SW¼SE¼ sec. 26, T. 2 N., R. 18 E.	Loess	240–16	0 to 7	Ap	109	15				
		240–17	19 to 20	B2	112	15				
		240–18	46 to 60	C12	111	13				
Walla Walla silt loam: SE¼SW¼ sec. 25, T. 1 N., R. 16 E.	Loess	240–13	0 to 7	Ap	104	14				
		240–14	25 to 34	B2	107	15				
		240–15	50 to 66	C12	113	13				
SE¼SW¼SE¼ sec. 20, T. 1 S., R. 17 E.	Loess	240–7	0 to 7	Ap	96	18				
		240–8	13 to 23	B2	105	16				
		240–9	57 to 70	Cca2	103	18				

[1] Based on the Moisture-Density Relations of Soils, Using 5.5-lb. Rammer and 12-in. Drop. AASHO Designation: T 99–57, Method A.

[2] Mechanical analysis according to the AASHO Designation: T 88–54. Results from this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes for soils.

soil samples taken from 12 soil profiles

the Lickskillet soils from Sherman County, Oreg., and on the Ritzville and Sagemoor soils from Walla Walla County, Wash., performed University, in cooperation with the Oregon State Highway Department and the U.S. Department of Commerce, Bureau of Public Roads]

Mechanical analysis [2]—Continued											Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued							Percentage smaller than—							
¾ in.	⅜ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0. 05 mm.	0. 02 mm.	0.005 mm.	0.002 mm.			AASHO [3]	Unified [4]
98	97	96	93	81	76	65	58	40	19	13	30	8	A-4(6)	ML-CL.
95	93	91	84	76	73	66	61	41	24	18	39	17	A-6(9)	CL.
88	82	76	67	53	49	37	34	21	11	9	27	6	A-4(1)	SM-SC.
90	86	80	65	51	47	38	35	25	17	13	42	17	A-7-6(3)	SM-SC.
------	------	------	100	98	96	88	73	47	20	12	25	4	A-4(8)	ML-CL.
------	------	------	100	97	95	87	73	44	16	9	26	4	A-4(8)	ML-CL.
------	------	------	100	95	91	81	69	43	17	9	26	4	A-4(8)	ML-CL.
------	------	------	100	94	91	85	74	50	21	11	26	6	A-4(8)	ML-CL.
------	------	------	------	------	100	94	75	42	15	10	25	2	A-4(8)	ML.
------	------	------	------	------	100	94	74	40	13	8	25	1	A-4(8)	ML.
------	------	------	------	------	100	97	76	40	12	8	24	2	A-4(8)	ML.
------	------	------	100	99	99	89	67	35	13	9	24	0	A-4(8)	ML.
------	------	------	------	------	100	91	70	35	11	7	26	1	A-4(8)	ML.
------	------	------	100	99	98	90	72	39	11	6	(5)	(5)	A-4(8)	ML.
------	------	------	------	------	100	89	67	36	15	8	21	1	A-4(8)	ML.
------	------	------	------	------	100	92	77	49	20	10	23	1	A-4(8)	ML.
------	------	------	------	------	100	98	88	63	29	15	29	5	A-4(8)	ML-CL.
------	------	100	99	96	94	79	53	24	11	6	25	3	A-4(8)	ML.
100	------	99	99	95	93	81	54	23	11	6	30	8	A-4(8)	ML-CL.
98	------	96	92	88	87	75	48	25	11	7	30	7	A-4(8)	ML-CL.
------	------	------	------	100	95	65	35	13	7	4	23	3	A-4(6)	ML.
------	------	------	------	100	99	81	42	17	8	5	26	8	A-4(8)	CL.
------	------	------	------	100	99	84	45	14	5	4	25	5	A-4(8)	ML-CL.
------	------	------	------	100	98	88	55	23	9	4	(5)	(5)	A-4(8)	ML.
------	------	------	------	100	99	92	60	27	12	7	26	5	A-4(8)	ML-CL.
------	------	------	------	100	98	87	48	21	8	4	(5)	(5)	A-4(8)	ML.
------	------	------	------	100	97	83	46	20	10	7	(5)	(5)	A-4(8)	ML.
------	------	------	------	100	99	94	60	22	12	9	27	6	A-4(8)	ML-CL.
------	------	------	------	100	98	91	49	18	9	6	21	2	A-4(8)	ML.
------	------	------	100	99	97	86	65	33	13	7	23	2	A-4(8)	ML.
------	------	------	------	100	99	91	70	37	16	9	28	8	A-4(8)	CL.
------	------	------	------	100	98	83	55	27	13	8	23	4	A-4(8)	ML-CL.
------	------	------	100	99	96	71	48	25	9	4	29	3	A-4(7)	ML.
------	------	------	100	99	97	82	63	35	11	5	27	4	A-4(8)	ML-CL.
------	------	------	100	99	97	84	59	27	7	3	25	3	A-4(8)	ML.

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation: M 145-49.

[4] Based on The Unified Soil Classification System, Technical Memorandum No. 3-357, Vol. 1, Waterways Experiment Station, Corps of Engineers, March 1953.

[5] Nonplastic.

in accordance with standard procedures of the AASHO. Results of mechanical analyses made by this method frequently differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material, or that passing the number 200 sieve, is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of material up to 3 inches. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. A comparison of these and other systems of size limits for soil separates can be found in the PCA Soil Primer (*11*). Table 4 shows both the AASHO and the Unified classifications.

Engineering terms for soil separates and the range in size for each class of separates as used in the Unified classification system are shown in the following list.

	Size range
Cobbles	More than 3 in.
Gravel	3 in. to 4.76 mm. (No. 4 sieve).
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to 4.76 mm. (No. 4 sieve).
Sand	4.76 mm. (No. 4 sieve) to 0.074 mm. (No. 200 sieve).
Coarse sand	4.76 mm. (No. 4 sieve) to 2.0 mm. (No. 10 sieve).
Medium sand	2.0 mm. (No. 10 sieve) to 0.42 mm. (No. 40 sieve).
Fine sand	0.42 mm. (No. 40 sieve) to 0.074 mm. (No. 200 sieve).
Silt or clay	Less than 0.074 mm. (Below No. 200 sieve).

The engineering terms for soil separates and the range in size for each class of separates for the AASHO classification system are shown in the following list. The basic difference between the AASHO and the Unified classification systems is the size at which the sand and gravel particles are separated. In the Unified system the separation is made on the No. 4 sieve; in the AASHO system it is made on the No. 10 sieve.

	Size range
Boulders	More than 3 in.
Gravel	3 in. to 2 mm. (No. 10 sieve).
Coarse gravel	3 in. to 1 in.
Medium gravel	1 in. to ⅜ in.
Fine gravel	⅜ in. to 2.0 mm. (No. 10 sieve).
Sand	2.0 mm. (No. 10 sieve) to 0.074 mm. (No. 200 sieve).
Coarse sand	2.0 mm. (No. 10 sieve) to 0.42 mm. (No. 40 sieve).
Fine sand	0.42 mm. (No. 40 sieve) to 0.074 mm. (No. 200 sieve).
Silt	0.074 mm. (No. 200 sieve) to 0.005 mm.
Clay	Less than 0.005 mm.

Table 5 gives the estimated physical properties of untested soils, as determined by interpreting soil survey data. The soil horizons shown in this table correspond to the modal soil profiles described in the section "Soil Descriptions." The estimates for liquid limit and plasticity index were based largely on clay content. These estimates were checked with the estimates for optimum moisture and maximum dry density, which are also closely related to the amounts of various particle sizes.

Permeability of the soil was estimated as it occurs in place. The estimates were based partially on soil structure and porosity.

The shrink-swell potential is an indication of the volume change to be expected with a change in moisture content. In general, soils classified as CH and A–7 have a "high" shrink-swell potential. Clean sands and gravels (single-grain structure) and those having small amounts of nonplastic to slightly plastic fines, as well as most other nonplastic to slightly plastic soil materials, have a "low" shrink-swell potential.

Hydrologic soil groupings

The soils have been placed in four hydrologic groups according to their ability to absorb water and according to loss of water through runoff. These data are needed to estimate the total volume and the peak rate of runoff from a rain of any given amount and intensity and are useful in planning water-control measures.

Group A consists of soils that absorb most storm precipitation and have the lowest runoff potential. Group D consists of soils that shed most storm precipitation and have the highest runoff potential. The texture and depth of the soils are not always the determining factors in hydrologic soil groupings. A moderately coarse textured soil may seal over under the impact of raindrops and may shed most of the precipitation; a finer textured soil may absorb the precipitation more readily.

Group A is made up of soils and miscellaneous land types that have a high rate of infiltration even when thoroughly wetted. It consists chiefly of deep, well-drained to excessively drained sandy and gravelly soils that have a high rate of water transmission that would result in a low runoff potential. These soils and land types are—

Dune land.
Quincy.
Riverwash.

Group B is made up of soils that have a moderate rate of infiltration when thoroughly wetted. It consists chiefly of moderately deep to deep, moderately fine textured to moderately coarse textured soils that are moderately well drained to somewhat excessively drained. These soils have a moderate rate of water transmission. They are—

Condon.
Walvan.
Hermiston.
Kuhl.
Nansene.
Ritzville.
Walla Walla.
Wrentham.

Group C is made up of soils that have a slow rate of infiltration when thoroughly wetted. It consists chiefly of (1) soils that have a layer that impedes the downward movement of water, and (2) moderately fine textured to fine textured soils. These soils have a slow rate of water transmission. They are—

Bakeoven.
Lickskillet.
Sagemoor.
Starbuck.

Group D is made up of soils and miscellaneous land types that have a very slow rate of infiltration when thoroughly wetted. It consists chiefly of (1) clayey soils that have a high swelling potential; (2) soils that have a high permanent water table; (3) soils that have a claypan or clay layer at or near the surface; and (4) shallow soils underlain by nearly impervious material. These soils and land types have a very slow rate of water transmission. They are—

Rock outcrop and rubble land.
Clayey basin land.
Pedigo.
Rock land.

Soil Descriptions

In this section the soil series of Sherman County are described in detail. Following the general description of each series, there is a discussion of the soils, or mapping units, in the series. The most nearly typical soil of each series is described in detail, and the others in the series are described more briefly, unless their depth or texture is significantly different from that of the typical soil (fig. 17). Further information on the use and management of soils both for crops and for range is given in the section "Use, Management, and Productivity of the Soils."

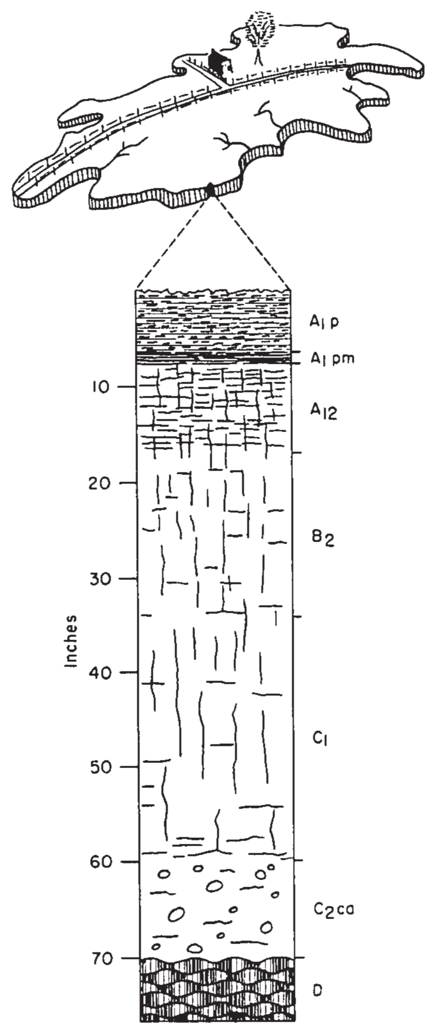

Figure 17.—**Diagram of one body of soil as shown on a soil map, and an enlarged sketch of a typical profile of Walla Walla silt loam. Horizons in the profile are: A1p—dark-colored, platy plow layer; A1pm—dark-colored, platy, compact plowpan; A12—dark-colored, thick, platy and prismatic subsurface layer; B2—coarse, prismatic subsoil, lighter colored than layer above; C1—light-colored, coarse, prismatic, floury parent material; C2ca—light-colored, nodular, calcareous parent material; D—basalt bedrock or hard caliche.**

A list showing the soils mapped in the county and the capability unit and range site of each is near the back of the report. The approximate acreage and the proportionate extent of the soils are given in table 6. The location and distribution of the soils are shown on the detailed soil map at the back of the report.

Bakeoven Series

Only one Bakeoven soil is mapped in Sherman County. This soil is locally known as scabland and is the shallowest soil in the county. It occurs on uplands throughout the county, but the areas are larger and more numerous in the southern half. It has formed from weathered basalt mixed with loess and is underlain by basalt bedrock. Most areas are gently sloping. The native vegetation consists mainly of Sandberg bluegrass, but about 90 percent or more of the surface is bare.

The surface soil, which in most places is only 1 or 2 inches thick, is brown or reddish-brown, slightly acid, weak platy to granular very stony loam. Where the range is in poor condition, a thin crust, about one-eighth of an inch thick, forms on the surface. Below this crust is a 1- to 2-inch vesicular layer.

The subsoil consists of slightly hard, neutral, heavy very stony loam or very stony clay loam. It is a shade lighter in color than the surface layer. The uppermost part of the subsoil is weak platy to granular; the lower part is subangular blocky. Bedrock is at a depth of 5 to 12 inches.

Natural drainage is good, and permeability is moderately slow in the subsoil.

The Bakeoven soil is associated mainly with the Condon, Starbuck, and Lickskillet soils.

Bakeoven very stony loam, 2 to 20 percent slopes (BaB).—This very shallow, very stony soil (fig. 18) commonly has slopes of 2 to 8 percent, but in places the slope is as much as 20 percent. Most areas are long and narrow

Figure **18.—Profile of Bakeoven very stony loam, 2 to 20 percent slopes. The depth to bedrock is less than 1 foot. Note highly fractured basalt bedrock**

TABLE 5.—*Estimated physical properties of untested soils in*

Soil series	Drainage	Depth from surface (typical profile)	Horizon	Classification		Grain size	
				Unified	AASHO	Percentage passing sieve—	
						No. 200 (0.074 mm.)	No. 4 (4.7 mm.)
		Inches					
Bakeoven (BaB)	Good.	0 to 2	A1	GM-GC	A-2-4(0)	25	35
		2 to 7	B21, B22	GM-GC	A-2-4(0)	30	40
Condon (CbA, CbBN, CbCN, CcB, CcCN, CdA, CdBN, CeB)	Good.	0 to 11	A11, A12	ML	A-4(8)	85	100
		11 to 18	B2	ML-CL	A-4(8)	84	100
		18 to 26	B3	ML-CL	A-4(8)	76	98
Clayey basin land (Ca)	Imperfect.	0 to 15	A1p, A12	CH	A-7-6(20)	95	100
		15 to 24	AC	CH	A-7-6(20)	95	100
		24 to 47	C1ca, C2	ML-CL	A-6(10)	91	100
Hermiston (HeA)	Imperfect.	0 to 8	Ap	ML	A-4(8)	85	100
		8 to 14	AC	ML-CL	A-4(8)	85	100
		14 to 37	C1, C2	SM	A-4(3)	50	99
		37 to 58	IIC3	ML-CL	A-4(8)	92	99
Kuhl (KhCN, KrB, KvCN)	Good.	0 to 5	A1	ML	A-4(8)	80	90
		5 to 17	B1, B2	CL	A-4(8)	80	90
Nansene (NaD)	Good.	0 to 20	A11, A12, A13.	ML-CL	A-4(8)	88	99
		20 to 37	AC	ML-CL	A-4(8)	88	99
		37 to 54	C	ML-CL	A-4(8)	87	90
Pedigo (Pe)	Poor.	0 to 16	A11, A12, A13.	CL	A-4(8)	92	100
		16 to 35	AC, C	CL	A-6(10)	95	100
		35 to 84	D1, D2	SM	A-4(8)	40	98
Quincy (QnB)	Somewhat excessive.	0 to 7	A1	SM	A-2-4(0)	35	99
		7 to 30	C1, C2	SM	A-2-4(0)	35	99
Sandy alluvial land (Sd)	Somewhat excessive.	0 to 7	A1	ML	A-4(4)	55	99
		7 to 28	AC1, AC2	ML	A-4(4)	55	99
		28 to 78	C1, C2, C3	SM	A-4(2)	45	99
		78+	D	ML	A-4(5)	60	99
Starbuck (SrB, StCS, SvDS, SxB)	Good.	0 to 7	A11, A12	ML-CL	A-4(6)	65	80
		7 to 14	AC	ML-CL	A-4(6)	66	80
Walvan (WvB)	Good.	0 to 7	Ap	ML	A-4(8)	88	100
		7 to 17	AC1	ML-CL	A-4(8)	92	100
		30 to 60	Clca, C2m, C3ca.	ML	A-4(8)	87	100
Wrentham (WxD)	Good.	0 to 12	A11, A12	CL	A-4(8)	82	90
		12 to 35	B1, B2	ML-CL	A-4(5)	60	85

[1] NP=nonplastic.

the county as determined by interpreting soil survey data

Liquid limit	Plasticity index	Permeability	pH	Alkali or salt	Shrink-swell potential	Other significant characteristics of the series
		In. per hr.				
28	7	0.8 to 2.5	6.5 to 6.8	None	Low.	Very stony, 40 to 60 percent of stones larger than 3 inches; very shallow.
35	10	0.8 to 2.5	6.7 to 7	None	Low.	
29	4	0.8 to 2.5	6.5 to 6.8	None	Low.	
33	10	0.8 to 2.5	6.7 to 7	None	Low.	
26	4	0.8 to 2.5	6.9 to 7.3	None	Low.	
60	32	0.05 to 0.2	6.3 to 6.8	None	High.	Wet until late in spring; calcareous.
60	32	0.05 to 0.2	7 to 7.4	None	High.	
40	15	0.2 to 0.8	7.2 to 7.7	None	Moderate to low.	
23	3	2.5 to 5	7.3 to 7.8	None to strong	Low.	Small areas affected by seepage.
25	6	2.5 to 5	7.7 to 8.2	Moderate to strong	Low.	
[1] NP	NP	2.5 to 5	8.2 to 8.6	Strong	Low.	
30	8	0.8 to 2.5	8.6 to 9.6	Strong	Low.	
23	2	0.8 to 2.5	6.6 to 6.9	Strong	Low.	Stony.
28	8	0.8 to 2.5	6.9 to 7.2	Strong	Low.	
26	4	2.5 to 5	6.4 to 6.8	Strong	Low.	Very steep; rock outcrops.
27	6	2.5 to 5	6.5 to 6.9	Strong	Low.	
25	4	2.5 to 5	6.5 to 6.9	Strong	Low.	
30	10	0.8 to 2.5	8.4 to 8.8	Moderate to strong	Low.	High water table.
40	18	0.2 to 0.8	8 to 8.4	Moderate	Moderate.	
NP	NP	5 to 10	8 to 8.4	Moderate	Low.	
NP	NP	5 to 10	6.9 to 7.3	None	Low.	
NP	NP	5 to 10	7.1 to 7.5	None	Low.	
NP	NP	5 to 10	6.7 to 7.8	None to strong	Low.	Small areas affected by seepage; fluctuating water table.
NP	NP	5 to 10	6.9 to 8.6	None to strong	Low.	
NP	NP	5 to 10	7.2 to 8.5	None to strong	Low.	
NP	NP	2.5 to 5	6.8 to 7.4	None to strong	Low.	
25	4	0.8 to 2.5	6.9 to 7.2	None	Low.	Stony.
26	4	0.8 to 2.5	6.9 to 7.2	None	Low.	
NP	NP	2.5 to 5	6.7 to 7.1	None	Low.	C horizon calcareous.
26	5	2.5 to 5	6.7 to 7.1	None	Low.	
NP	NP	2.5 to 5	7.8 to 8.4	None to slight	Low.	
28	8	0.8 to 2.5	6.5 to 6.8	None	Low.	Very steep; rock outcrops.
32	10	0.8 to 2.5	6.2 to 6.6	None	Low.	

TABLE 6.—*Approximate acreage and proportionate extent of the soils*

Symbol	Soil	Distribution according to use—				Approximate acreage	Proportionate extent
		Range	Idle [1]	Perennial seedings [2]	Crops		
		Acres	*Acres*	*Acres*	*Acres*		*Percent*
BaB	Bakeoven very stony loam, 2 to 20 percent slopes	5, 965				5, 965	1. 1
Ca	Clayey basin land	5			174	179	(3)
CbA	Condon silt loam, 1 to 7 percent slopes	6, 117	784	4, 036	72, 098	83, 035	15. 7
CbBN	Condon silt loam, 7 to 20 percent north slopes	3, 082	188	851	11, 086	15, 207	2. 9
CbCN	Condon silt loam, 20 to 35 percent north slopes	2, 403	13	22	265	2, 703	. 5
CdA	Condon silt loam, deep, 1 to 7 percent slopes	99	8	117	15, 664	15, 888	3. 0
CdBN	Condon silt loam, deep, 7 to 20 percent north slopes	190	63	40	2, 766	3, 059	. 6
CcB	Condon silt loam, shallow variant, 3 to 15 percent slopes	967	202	225	773	2, 167	. 4
CcCN	Condon silt loam, shallow variant, 15 to 35 percent north slopes.	575			6	581	. 1
CeB	Condon-Bakeoven complex, 2 to 20 percent slopes	45, 431	4	148		45, 583	8. 6
De	Dune land	166				166	(3)
HeA	Hermiston loam, 0 to 5 percent slopes	1, 242		179	249	1, 670	. 3
KhCN	Kuhl stony silt loam, 10 to 35 percent north slopes	1, 516				1, 516	. 3
KrB	Kuhl very rocky very fine sandy loam, 3 to 7 percent slopes	882			9	891	. 2
KvCN	Kuhl very stony very fine sandy loam, 7 to 35 percent north slopes	661				661	. 1
LiCS	Lickskillet very stony loam, 7 to 40 percent south slopes	11, 338				11, 338	2. 1
LsDS	Lickskillet extremely stony loam, 40 to 70 percent south slopes	35, 953				35, 953	6. 8
LsDN	Lickskillet extremely stony loam, 40 to 70 percent north slopes	1, 337				1, 337	. 3
NaD	Nansene rocky silt loam, 35 to 70 percent slopes	14, 111				14, 111	2. 7
Pe	Pedigo silt loam	33		125	17	175	(3)
QnB	Quincy loamy fine sand, 0 to 20 percent slopes	690				690	. 1
RiA	Ritzville silt loam, 2 to 7 percent slopes	174	243	19	4, 442	4, 878	. 9
RiBN	Ritzville silt loam, 7 to 20 percent north slopes	207	76	8	1, 642	1, 933	. 4
RtA	Ritzville silt loam, moderately deep, 2 to 7 percent slopes	666	308	105	2, 504	3, 583	. 7
RtBN	Ritzville silt loam, moderately deep, 7 to 20 percent north slopes	406	85		1, 069	1, 560	. 3
RtBS	Ritzville silt loam, moderately deep, 7 to 20 percent south slopes	431	146	80	1, 885	2, 542	. 5
RtCN	Ritzville silt loam, moderately deep, 20 to 35 percent north slopes	590	46		7	643	. 1
Rv	Riverwash	2, 530				2, 530	. 5
Rw	Rock outcrop and rubble land	25, 119				25, 119	4. 8
Rx	Rock land	362				362	. 1
SaC	Sagemoor silt loam, 5 to 40 percent slopes	3, 820			32	3, 852	. 7
Sd	Sandy alluvial land	3, 268	31	215	293	3, 807	. 7
StCS	Starbuck very stony silt loam, 7 to 40 percent south slopes	4, 530	2	95		4, 627	. 9
SrB	Starbuck stony silt loam, 4 to 20 percent slopes	1, 203	10	72	4	1, 289	. 2
SvDS	Starbuck extremely stony silt loam, 40 to 70 percent south slopes	3, 537	2			3, 539	. 7
SxB	Starbuck-Bakeoven complex, 2 to 20 percent slopes	8, 832	2	41		8, 875	1. 7
WaA	Walla Walla silt loam, very deep, 3 to 7 percent slopes	159	13	229	28, 401	28, 802	5. 4
WaBN	Walla Walla silt loam, very deep, 7 to 20 percent north slopes	230	19	152	14, 091	14, 492	2. 7
WaBS	Walla Walla silt loam, very deep, 7 to 20 percent south slopes	45		18	3, 303	3, 366	. 6
WaCN	Walla Walla silt loam, very deep, 20 to 35 percent north slopes	205	14	72	818	1, 109	. 2
WbA	Walla Walla silt loam, deep, 3 to 7 percent slopes	54	14	63	2, 652	2, 783	. 5
WbBN	Walla Walla silt loam, deep, 7 to 20 percent north slopes	123		17	1, 069	1, 209	. 2
WbBS	Walla Walla silt loam, deep, 7 to 20 percent south slopes	76	2	53	3, 592	3, 723	. 7
WcA	Walla Walla silt loam, moderately deep, 3 to 7 percent slopes	219		159	2, 145	2, 523	. 5
WcBN	Walla Walla silt loam, moderately deep, 7 to 20 percent north slopes	51		25	492	568	. 1
WcBS	Walla Walla silt loam, moderately deep, 7 to 20 percent south slopes	316	18	307	4, 273	4, 914	. 9
WcCN	Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes	575		35	103	713	. 1
WdA	Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes	123	8	118	14, 091	14, 340	2. 7
WdBN	Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent north slopes	157	8	49	6, 054	6, 268	1. 2
WdBS	Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent south slopes	43		11	3, 416	3, 470	. 7
WdCN	Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent north slopes	421	47	50	1, 723	2, 241	. 4

See footnotes at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils*—Continued

Symbol	Soil	Distribution according to use—				Approximate acreage	Proportionate extent
		Range	Idle [1]	Perennial seedings [2]	Crops		
		Acres	*Acres*	*Acres*	*Acres*		*Percent*
WdCS	Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent south slopes	128	-----	-----	996	1, 124	. 2
WeA	Walla Walla silt loam, coarse solum, deep, 3 to 7 percent slopes	108	36	130	5, 203	5, 477	
WeBN	Walla Walla silt loam, coarse solum, deep, 7 to 20 percent north slopes	70	-----	13	1, 050	1, 133	. 2
WeBS	Walla Walla silt loam, coarse solum, deep, 7 to 20 percent south slopes	39	27	5	2, 904	2, 975	. 6
WeCN	Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes	614	-----	35	167	816	. 2
WeCS	Walla Walla silt loam, coarse solum, deep, 20 to 35 percent south slopes	112	-----	19	429	560	. 1
WgA	Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes	240	18	140	4, 032	4, 430	. 8
WgBN	Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent north slopes	371	41	72	190	674	. 1
WgBS	Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent south slopes	66	6	97	1, 143	1, 312	. 3
WgCS	Walla Walla silt loam, coarse solum, moderately deep, 20 to 35 percent south slopes	127	12	10	410	559	. 1
WhA	Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes	55	-----	204	14, 897	15, 156	2.
WhBN	Walla Walla silt loam, low rainfall, very deep, 7 to 20 percent north slopes	70	6	52	4, 673	4, 801	. 9
WhCN	Walla Walla silt loam, low rainfall, very deep, 20 to 35 percent north slopes	328	8	71	420	827	. 2
WkA	Walla Walla silt loam, low rainfall, deep, 3 to 7 percent slopes	78	31	187	11, 527	11, 823	2. 2
WkBN	Walla Walla silt loam, low rainfall, deep, 7 to 20 percent north slopes	142	19	68	4, 066	4, 295	. 8
WkBS	Walla Walla silt loam, low rainfall, deep, 7 to 20 percent south slopes	18	-----	6	1, 056	1, 080	. 2
WmA	Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes	907	51	729	9, 794	11, 481	2. 2
WmBN	Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent north slopes	132	7	103	1, 320	1, 562	. 3
WmBS	Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes	1, 020	158	547	6, 177	7, 902	1. 5
WmCN	Walla Walla silt loam, low rainfall, moderately deep, 20 to 35 percent north slopes	410	-----	10	121	541	. 1
WnA	Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes	241	293	137	2, 695	3, 366	. 6
WnBN	Walla Walla very fine sandy loam, deep, 7 to 20 percent north slopes	311	366	72	2, 957	3, 706	. 7
WnBS	Walla Walla very fine sandy loam, deep, 7 to 20 percent south slopes	204	252	31	2, 542	3, 029	. 6
WnCN	Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes	740	92	69	674	1, 575	. 3
WnCS	Walla Walla very fine sandy loam, deep, 20 to 35 percent south slopes	296	52	10	511	869	. 2
WoA	Walla Walla very fine sandy loam, moderately deep, 3 to 7 percent slopes	164	65	7	801	1, 037	. 2
WoBS	Walla Walla very fine sandy loam, moderately deep, 7 to 20 percent south slopes	52	123	-----	505	680	. 1
WoCS	Walla Walla very fine sandy loam, moderately deep, 20 to 35 percent south slopes	161	3	-----	70	234	([3])
WvB	Walvan loam, 2 to 10 percent slopes	133	8	34	968	1, 143	. 2
WxD	Wrentham rocky silt loam, 35 to 70 percent slopes	26, 959	-----	-----	-----	26, 959	5. 1
	Total acreage of map units	225, 531	4, 030	10, 594	283, 506	523, 661	98. 9
	Roads and railroads	-----	-----	-----	-----	4, 789	. 9
	City and built-up areas	-----	-----	-----	-----	830	. 2
	Total	-----	-----	-----	-----	[4] 529, 280	100. 0

[1] Idle land includes abandoned cropland that has not been seeded to perennial grasses or legumes.

[2] Perennial seedings includes areas that are irrigated for hay or pasture, and areas that are seeded to dry-type perennial grasses or legumes.

[3] Less than 0.1 of 1 percent.

[4] Total acreage of Sherman County, Oregon, excluding water surface areas of the Columbia, Deschutes, and John Day Rivers.

and are between 10 and 60 acres in size. In the southern part of the county, this soil occurs downslope from Condon silt loam and upslope from the extremely stony Lickskillet soils, which are on canyon slopes. Near Kent, it occurs along intermittent field drainageways, adjacent to Condon silt loam. Except for small areas that are mapped as part of complexes, there is little Bakeoven soil in the northern half of the county. Condon soils that occur as mounds, or biscuits, make up as much as 15 percent of this mapping unit.

Representative profile in native range, 4 percent southeast-facing slope, in SW¼NE¼SE¼ sec. 6, T. 4 S., R. 15 E.

A1—0 to 2 inches, brown (7.5YR 5/3) very stony loam, dark brown (7.5YR 3/2) when moist; weak, thin, platy structure breaking to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many to few roots; many, fine interstitial pores; about 20 percent, by volume, fine fragments of basalt from 2 to 5 millimeters in diameter; slightly acid (pH 6.5); abrupt, smooth boundary.

B1—2 to 5 inches, brown (7.5YR 5/3) very stony clay loam, dark brown (7.5YR 3/3) when moist; weak, thin, platy structure breaking to weak, fine and medium, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many to few roots; common, fine, interstitial and tubular pores; many, thin, discontinuous clay films on ped surfaces and in larger pores; about 20 percent, by volume, fine fragments of basalt from 2 to 5 millimeters in diameter; neutral (pH 6.8); abrupt, smooth boundary.

B2—5 to 7 inches, brown (10YR 5/4) very stony clay loam, dark yellowish brown (10YR 3/4) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many to few roots; few, fine, tubular pores; thick, continuous clay films on ped surfaces and in larger pores; about 20 percent, by volume, fine fragments of basalt from 2 to 5 millimeters in diameter; neutral (pH 6.9); abrupt, wavy boundary.

Dr—7 inches +, basalt bedrock.

The Bakeoven soil has a very shallow root zone. It is very low in moisture-supplying capacity and very low in fertility. Runoff is slow to rapid. In most places, runoff begins quickly after rains because the soil holds little water. A few areas that are encircled by Condon soils are ponded for short periods following heavy rains or rapid snowmelt. Water erosion is a moderate hazard.

This soil is too shallow and too stony to be cultivated. It is used only for grazing. *Capability unit VIIs-1; Scabland range site.*

Clayey basin land (Ca).—This miscellaneous land type occurs in the vicinity of Wilcox, in a depression that was under water as recently as 75 years ago.

The surface layer ranges in texture from silty clay, which is most common, to clay, silty clay loam, or silt loam. When the soil is dry, cracks about 1 inch in width and 24 inches in depth develop. In fall and winter, when the soil becomes moist and swells, the cracks disappear.

Walvan loam, 2 to 10 percent slopes, is on terraces adjacent to Clayey basin land, and small areas of the Walvan soil are included in this land type.

Surface runoff is very slow on Clayey basin land, and there is no erosion hazard. Natural drainage is imperfect, permeability is slow, and the moisture-supplying capacity is very high. The root zone is deep, and fertility is moderate. Workability is only fair, and generally tillage must be postponed until later in spring than on the nearby Condon and Walvan soils.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIw-1; hay and pasture group 4.*

Condon Series

The Condon series consists of soils that average about 30 inches in depth to basalt bedrock. These soils have formed in loess mixed with small amounts of volcanic ash. They are dominant on the uplands in the southern half of the county. In most places they are gently sloping, but in some places they are moderately steep to steep. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass.

The surface layer, which extends to a depth of 7 to 12 inches, is slightly hard, grayish-brown, neutral silt loam. It is weak platy to granular under natural conditions but puddles readily in cultivated areas and in areas where the range is in poor condition. When the soil dries, a hard crust forms on the surface and slows the infiltration of water.

The subsoil is slightly hard, brown to pale-brown, neutral, weak prismatic silt loam that contains a little more clay than the surface layer. The depth to basalt bedrock generally is from 18 to 38 inches, but in places it is as much as or slightly more than 60 inches. Where the soil is more than 34 inches deep, the subsoil is underlain by yellowish-brown, massive, silty or sandy material, which in places is calcareous. In most places small fragments of basalt are scattered throughout the profile.

The Condon soils hold about 0.21 inch of available moisture per inch of depth. Natural drainage is good, and permeability is moderate.

The Condon soils are used mainly for growing wheat. but large areas are in native range. They are associated with the Wrentham, Lickskillet, and Bakeoven soils.

Condon silt loam, 1 to 7 percent slopes (CbA).—Extensive areas of this soil occur on the broad ridgetops in the southern part of the county. Most areas have slopes of 2 to 4 percent.

Representative profile in native range, 6 percent west-facing slope, in NE¼SE¼ sec. 5, T. 3 S., R. 17 E.

A11—0 to 3 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, platy structure breaking to weak, medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; common, fine, interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

A12—3 to 12 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; common, fine, tubular pores; neutral (pH 6.7); clear, smooth boundary.

B21—12 to 19 inches, brown (10YR 5/3) heavy silt loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; common, fine, tubular pores; thin, patchy clay films on ped surfaces and in larger pores; neutral (pH 6.8); gradual, smooth boundary.

B22—19 to 30 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; common, fine, tubular pores; thin, patchy clay films on ped surfaces and in larger pores; neutral (pH 7.2); abrupt, smooth boundary.

D—30 inches +, basalt rock, fragmented and lime coated.

The maximum range in the depth to basalt bedrock is 18 to 38 inches, but near Wilcox and eastward to the John Day River, and southward and westward to the Wasco County line, the depth ranges from 18 to 32 inches and averages about 22 inches. Basalt fragments, $\frac{1}{16}$ to $\frac{1}{2}$ inch in size, are scattered on the surface and throughout the profile. In a few places there are some angular pieces of basalt as much as 15 inches in diameter. In cultivated areas and on range where the vegetation is sparse, there is a surface crust that is from $\frac{1}{8}$ to $\frac{1}{4}$ inch thick. Below this crust, there is a 1- to 3-inch vesicular layer. Near Kent, there are a few areas that have several inches of stratified sandy or silty material immediately above the basalt.

Other Condon silt loams make up about 5 percent of this mapping unit. Small areas of Wrentham, Bakeoven, and Walvan soils are also included.

Runoff is slow on Condon silt loam, 1 to 7 percent slopes, and the hazard of water erosion is slight. The moisture-supplying capacity is fair. Normally the moisture content is at capacity in winter, but rains are needed late in spring to produce an average grain crop. This soil is moderate in fertility and is easy to work. In places, however, tillage and harvesting are problems because of the small areas of included stony soils. Tillage is 2 to 4 weeks later in spring than on the soils in the northern half of the county. In some cultivated areas, a compacted layer forms just below the plow layer and reduces the rate at which water moves through the soil.

This soil is used mainly for wheat and barley. The response of wheat to nitrogen fertilizer is low. *Capability Unit IIIs–1; Rolling Hills range site; hay and pasture group 3.*

Condon silt loam, 7 to 20 percent north slopes (CbBN).—This soil has lost 2 or more inches of the original surface layer through erosion. It occurs downslope from larger areas of more gently sloping Condon soils and upslope from steeper Condon soils. As much as 8 percent of this mapping unit consists of other Condon silt loams, and as much as 5 percent of Wrentham, Bakeoven, and Walvan soils.

Runoff is rapid, and the hazard of water erosion is moderate. The moisture-supplying capacity is good except in a few areas that have southern exposure. In these areas, it is fair. Fertility is moderate. Workability is good, but tillage and harvesting operations are more difficult than on gently sloping Condon soils.

About three-fourths of the acreage is used for wheat. The rest is used mainly for range. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIe–3; Droughty North Exposure range site; hay and pasture group 2.*

Condon silt loam, 20 to 35 percent north slopes (CbCN).—This soil has a slightly darker colored surface layer than Condon silt loam, 1 to 7 percent slopes, and it averages about 36 inches in depth. It occurs downslope from the less sloping Condon soils and upslope from Wrentham rocky silt loam, 35 to 70 percent slopes. As much as 10 percent of this mapping unit is the Wrentham soil or other Condon soils.

Runoff is medium in areas that have a dense cover of grass and very rapid in cultivated areas. Water erosion is a serious hazard. The moisture-supplying capacity is good; workability is poor; and fertility is moderate.

Most of the acreage is used for range; a few areas are used for growing wheat and barley. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe–1; Droughty North Exposure range site; hay and pasture group 2.*

Condon silt loam, deep, 1 to 7 percent slopes (CdA).—This soil has a dominant slope range of 3 to 5 percent. It is more than 38 inches in depth to basalt, and there are a few fragments of basalt mixed in the soil material. In places this soil has a C horizon that is 2 feet thick and is weakly calcareous in the lower part.

This soil is finer textured than Walla Walla silt loam, deep, 3 to 7 percent slopes, and it is more strongly developed. In many places it is adjacent to or surrounded by Condon silt loam, 1 to 7 percent slopes. The largest areas are where the Condon soils join the Walla Walla soils in a transitional zone that extends from east to west, approximately parallel to Nigger Ridge.

Other Condon soils make up as much as 10 percent of this mapping unit. Small areas of Walla Walla silt loams are also included.

The moisture-supplying capacity of this soil is high. Runoff is slow, and the erosion hazard is slight. Fertility is high, and workability is very good.

Most of the acreage is used for growing wheat and barley. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIc–1; Rolling Hills range site; hay and pasture group 1.*

Condon silt loam, deep, 7 to 20 percent north slopes (CdBN).—This soil is downslope from gently sloping Condon soils and upslope from steeper Condon soils. It is slightly finer textured than Walla Walla silt loam, deep, 7 to 20 percent north slopes. Where the range is in good condition, the surface layer is about 2 inches thicker than that of Condon silt loam, deep, 1 to 7 percent slopes. In cultivated areas, the surface layer is about 2 inches thinner because of erosion.

About 10 percent of this mapping unit consists of other Condon silt loams and small areas of Walla Walla or Wrentham soils.

Runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is high; fertility is high; and workability is good, but not so good as on the gently sloping Condon soils.

Most of the acreage is used for growing wheat and barley. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe–1; Droughty North Exposure range site; hay and pasture group 1.*

Condon silt loam, shallow variant, 3 to 15 percent slopes (CcB).—This shallow soil occurs most commonly along the outer edges of ridgetops, between the deeper Condon silt loams and the Bakeoven or the Lickskillet soils. It also occurs in narrow strips, 5 to 30 feet in width, along intermittent drainageways, but these areas are too small to be mapped separately and are included in other mapping units.

The surface layer is 5 to 7 inches of brown, friable, neutral silt loam that has weak platy to weak granular structure.

The subsoil is brown to yellowish-brown, friable, neutral, heavy silt loam that has a weak prismatic structure. Basalt bedrock is at a depth of 13 to 18 inches. Many small fragments of basalt, from 1/16 to 1/2 inch in size, are mixed in the soil material.

As much as 10 percent of this mapping unit is other Condon silt loams, and as much as 5 percent is Lickskillet and Bakeoven soils.

Runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is low. Because of the shallowness of this soil and the small inclusions of stony soils, workability is only fair.

This soil is used for range and for growing wheat and barley. Wheat does not respond to nitrogen fertilizer, because of the shallowness of this soil. *Capability unit VIe-1; Droughty Rolling Hills range site; hay and pasture group 3.*

Condon silt loam, shallow variant, 15 to 35 percent north slopes (CcCN).—This soil is one of the least extensive soils in the county. It is downslope from the deeper Condon soils and upslope from Wrentham rocky silt loam, 35 to 70 percent slopes. Small areas of these soils are included in this mapping unit.

Most of the acreage is used for range. Where the range is in good condition, runoff is medium; where it is in poor condition or where the vegetation is sparse, runoff is rapid. The hazard of erosion is moderate to severe. Workability is very poor because of the steep slopes and the small inclusions of stony soils. Fertility is low. Reseeding is difficult. *Capability unit VIe-1; Droughty North Exposure range site; hay and pasture group 3.*

Condon-Bakeoven complex, 2 to 20 percent slopes (CeB).—Locally, these soils are known as biscuit scabland (figs. 19 and 20). Condon silt loam makes up from 15 to 85 percent of this complex. The dominant slope range is 5 to 9 percent. Where the slope is less than 9 percent, the Condon soil occurs as circular mounds, or biscuits, that have a convex surface and are deepest in the center. Where the slope is more than 9 percent, the Condon soil commonly occurs as elongated mounds with the long axis downslope, but in places it also occurs as circular mounds. The circular mounds are from 15 to 40 feet in diameter and about 20 feet apart. The elongated mounds are from 100 to 300 feet in length and from 30 to 60 feet in width. In most areas, the mounds occupy about 20 percent of the ground surface. The Bakeoven soil occurs as scabland between and around the mounds. This complex generally is not affected by a northerly or southerly exposure.

The Condon soil in this complex is browner and contains more small fragments of basalt than Condon silt loam, 1 to 7 percent slopes (fig. 21). The Bakeoven soil is essentially the same as Bakeoven very stony loam, 2 to 20 percent slopes.

This complex occurs mostly south of Nigger Ridge. Toward the southern part of the county, the areas are larger and progressively more common. At the higher elevations, they are adjacent to the Condon silt loams. Where the ridgetops begin to break to the canyons, they are adjacent to Bakeoven very stony loam, 2 to 20 percent slopes, or to Lickskillet very stony loam, 7 to 20 percent

Figure 20.—**Cross section of biscuit-scabland complex. Biscuit is Condon silt loam; scabland is Bakeoven very stony loam. Highly fractured basalt underlies scabland; relatively solid basalt underlies the biscuit.**

Figure 19.—**View of biscuit scabland. The mounds, or biscuits, are Condon soil, and surrounding the mounds is the very shallow Bakeoven soil.**

Figure 21.—**A complex of Condon and Bakeoven soils in a natural drainageway typical of many in the southern part of the county. Summer fallow on Condon silt loam, 1 to 7 percent slopes.**

south slopes, and these soils make up as much as 10 percent of this mapping unit.

Runoff is slow to rapid. The hazard of water erosion varies from slight where the range is in good condition to moderate where it is in poor condition. The moisture-supplying capacity is fair in the Condon soil and very low in the Bakeoven soil. Internal drainage is slightly more rapid in the Condon soil than in Condon silt loam, 1 to 7 percent slopes.

All of the acreage is used for grazing. In places the mounds have been roughly leveled, and the Bakeoven soil is buried. These areas are adjacent to other Condon silt loams and are mapped as inclusions with them. *Capability unit VIIs-1; Biscuit-Scabland Complex range site.*

Dune land (De).—This miscellaneous land type consists of areas on which drifted sand has been piled by the wind. These dune areas are small. Only a few are more than 10 acres in size. The slope range is 5 to 25 percent.

The dunes are related to present or extinct shorelines. They occur mostly in the extreme northern part of the county in association with the Walla Walla and Quincy soils and with Riverwash. They are advancing in the direction of the prevailing westerly wind and are burying adjacent soils.

Dune land is nearly devoid of vegetation and is not suitable for grazing. Improved perennial grasses or nursery-grown plants or clones of Volga wildrye, planted 20 inches apart in rows spaced 20 inches apart, will stabilize these dunes if grazing is restricted. *Capability unit VIIIe-1.*

Hermiston Series

Only one Hermiston soil is mapped in Sherman County. This is a dark-colored, nearly level to gently sloping soil that occurs along streams. It consists of alluvium derived from loess and volcanic ash that has been washed from the uplands. The native vegetation consisted mainly of bluebunch wheatgrass, giant wildrye, and sagebrush.

The surface layer, which averages about 8 inches in thickness, is grayish-brown, weak platy, slightly hard silt loam, loam, or very fine sandy loam that is neutral to mildly alkaline. The subsoil, which extends to an average depth of 14 inches, is similar in texture and consistence but is brown and weak prismatic. The underlying material is mainly light-gray to light brownish-gray loam or sandy loam that is neutral to very strongly alkaline. In many places the soil is stratified and contains alternate layers of silty and sandy material; in some areas it is gravelly.

The Hermiston soil is moderately permeable. Most of the acreage has good natural drainage, but about 5 percent is wet most or all of the year.

This soil is associated with loessal and residual upland soils in all parts of the county. Along the larger streams and rivers, it is adjacent to Riverwash and Sandy alluvial land. It is more alkaline in reaction, less uniform in texture, and lighter colored than the Walla Walla soils, but where the Hermiston and Walla Walla soils join, they are difficult to map separately.

Hermiston loam, 0 to 5 percent slopes (HeA).—This soil occurs in long, narrow strips adjacent to streams. The strips average about 100 yards in width, but in a few places they are as much as 200 yards wide. Individual areas are from 2 to 20 acres in size.

Representative profile in native range, 1 percent slope, in the NE¼NW¼ sec. 10, T. 1 S., R. 17 E.

A1—0 to 8 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; roots plentiful; many, very fine pores; pH 7.4; clear, smooth boundary.

AC—8 to 14 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; roots plentiful; many, very fine pores; pH 7.8, noncalcareous; clear, smooth boundary.

C1—14 to 26 inches, light-gray (10YR 7/2) fine sandy loam or loam, dark grayish brown (10YR 4/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; roots plentiful; few, hard nodules and white volcanic ash (pumice) spots; pH 8.4, calcareous; clear, wavy boundary.

C2—26 to 37 inches, light brownish-gray (10YR 6/2) fine sandy loam or loam, dark brown (10YR 4/3) when moist; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; few roots; many, fine, tubular pores; few, white volcanic ash spots; pH 8.4; calcareous; clear, wavy boundary.

C3—37 to 60 inches, light-gray (10YR 7/2) silt loam, dark brown (10YR 4/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few roots; many, fine pores; pH 9.4, calcareous.

The surface layer is silt loam, loam, or very fine sandy loam. The subsoil commonly consists of alternate layers of loamy or fine sandy material.

As much as 10 percent of this mapping unit is Sandy alluvial land, and as much as 5 percent is wet, strongly alkaline, or gravelly.

The Hermiston soil holds from 0.13 to 0.17 inch of available moisture per inch of depth. Surface runoff is slow, and the hazard of erosion is slight. In most places the moisture-supplying capacity is good, and in small wet areas it is very high most of the year. Fertility is high. In many places streambanks are subjected to severe cutting, and many cave in.

This soil is used principally for range. The range is heavily grazed and in most places is in poor condition. A few areas of this soil have been leveled, cleared of brush, irrigated, and used for pasture and hay plants. About 15 percent of the acreage is used for dryfarmed wheat. The response of wheat to nitrogen fertilizer is moderate. *Capability unit IIIs-2; Well-Drained Bottom range site; hay and pasture group 2.*

Kuhl Series

The Kuhl series consists of dark-colored, uniformly textured, stony or rocky soils. These soils occur on gentle to steep slopes in the northern half of the county. They have formed from loess under native vegetation that consisted principally of bluebunch wheatgrass and Idaho fescue.

The surface layer, which averages about 5 inches in thickness, is grayish-brown, slightly acid or neutral silt loam or very fine sandy loam. Under natural conditions, it is soft or slightly hard when dry and has weak platy structure. In most places it is stony, and in some places there are large outcrops of basalt.

The subsoil is brown, neutral, stony or rocky silt loam or very fine sandy loam that is slightly hard when dry and has weak, prismatic structure. The depth to basalt, which is the principal underlying material, averages about 18 inches but ranges from 10 to 40 inches.

The Kuhl soils are used only for grazing. They are well drained and are moderately permeable. They are associated chiefly with the Walla Walla soils.

Kuhl stony silt loam, 10 to 35 percent north slopes (KhCN).—This soil occurs on moderately steep to steep north-facing and east-facing slopes, mainly along the lower half of Grass Valley Canyon and the lower end of Hay Canyon.

Representative profile in native range, 30 percent north-facing slope, 165 feet east of fence, 180 feet south of draw, in SW¼NW¼ sec. 32, T. 1 N., R. 18 E.

A1—0 to 5 inches, grayish-brown (10YR 5/2) stony silt loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure breaking to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; common, very fine, tubular pores; pH 6.8; abrupt, smooth boundary.

B1—5 to 12 inches, brown (10YR 5/3) stony silt loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, very fine and common, fine, tubular pores; pH 7.0; clear, smooth boundary.

B2—12 to 17 inches, brown (10YR 5/3) stony silt loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; roots plentiful; common, very fine, tubular pores; pH 7.0; abrupt, wavy boundary.

D—17 inches +, basalt bedrock.

The surface layer ranges from 5 to 10 inches in thickness. Stones and small fragments of basalt, ⅛ to ½ inch in size, are on the surface and throughout the profile. In a few places there are outcrops of basalt and talus slides. As much as 10 percent of this mapping unit is Starbuck very stony silt loam, 7 to 40 percent south slopes.

Surface runoff is medium to rapid, and, where the vegetation is sparse, the hazard of erosion is moderate. The moisture-supplying capacity is low to good.

All of this soil is used for range. The reseeding of range that is in poor condition is feasible in only a few places. *Capability unit VIIs–1; Droughty North Exposure range site.*

Kuhl very rocky very fine sandy loam, 3 to 7 percent slopes (KrB).—This soil occurs only in the extreme northern part of the county. Most areas are adjacent to the steep and very steep soils on breaks along the Columbia River.

In many places the surface layer is only from 5 to 8 inches thick. Basalt bedrock is at a depth of 10 to 20 inches. Many fragments of basalt, ¼ to ½ inch in size, are mixed in the soil material. In a few small areas, the soil is underlain by caliche. Free lime seldom occurs except where pieces of caliche are mixed in the soil material. Waterworn gravel, consisting of both basalt and quartz, is fairly common. Outcrops of basalt occur in many places. Inclusions of Walla Walla very fine sandy loams make up as much as 10 percent of this mapping unit.

This soil cannot be cultivated, because of rock outcrops and stoniness. All of the acreage is used for range, but its value as range is low. The best seasons for grazing are late in spring and late in fall. *Capability unit VIIs–1; Droughty Rolling Hills range site.*

Kuhl very stony very fine sandy loam, 7 to 35 percent north slopes (KvCN).—This soil occurs only on north-facing slopes in the extreme northern part of the county. The depth to basalt averages about 20 inches, but it may be as little as 10 inches or as much as 40 inches.

The surface layer generally is as thick as that of the representative profile, but in some places it is as much as 16 inches thick. Stones and fragments of basalt, ¼ to ½ inch in size, are common. Waterworn gravel occurs in many places. Free lime occurs only in a few places.

This soil is adjacent to Nansene rocky silt loam, 35 to 70 percent slopes, which is on very steep north-facing canyon walls and on breaks along the Columbia River. As much as 10 percent of this mapping unit is the Nansene, Walla Walla, and other soils.

Surface runoff is slow to rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderate where the vegetation is sparse. The moisture-holding capacity is low to fair.

This soil is used only for range. It can be grazed later in spring and earlier in fall than Kuhl very rocky very fine sandy loam, 3 to 7 percent slopes, and its value for grazing is significantly higher. *Capability unit VIIs–1; Droughty North Exposure range site.*

Lickskillet Series

This series consists of very stony to extremely stony soils that are most commonly on south-facing canyon walls and on breaks to rivers. These soils occur throughout the county, but the largest areas are along the Deschutes and John Day Rivers. They have formed from weathered basalt mixed with loess. The native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass.

The surface layer, which averages about 5 inches in thickness, is brown or grayish-brown, slightly hard, platy to granular, very stony or extremely stony loam or clay loam that is slightly acid.

The subsoil is brown to yellowish-brown, hard, neutral, extremely stony heavy loam or clay loam. The uppermost part is subangular blocky; the lower part is prismatic breaking to subangular blocky. Basalt bedrock is at a depth of 12 to 24 inches.

These soils are well drained to somewhat excessively drained. The subsoil is moderately slow in permeability.

The Lickskillet soils are used only for grazing. They are associated with the Wrentham, Nansene, Sagemoor, and Bakeoven soils.

Lickskillet very stony loam, 7 to 40 percent south slopes (LiCS).—This soil has a dominant slope of 25 percent. The slopes are convex and are from 100 to 400 feet in length. On the very steep canyon breaks, this soil is adjacent to Lickskillet extremely stony loam, 40 to 70 percent south slopes; on ridgetops, it is adjacent to Bakeoven very stony loam, 2 to 20 percent slopes.

Representative profile in native range, 25 percent south-facing slope, in NW¼NE¼NW¼ sec. 9, T. 4 S., R. 18 E., about 0.2 mile east of section corner.

A1—0 to 5 inches, grayish-brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure breaking to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, interstitial pores; common, fine fragments of basalt as large as ½ inch in diameter; slightly acid (pH 6.4); abrupt, wavy boundary.

B1—5 to 9 inches, brown (10YR 5/3) very stony loam, dark brown (10YR 4/3) when moist; weak to moderate, medium to fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; abundant roots; common, fine, tubular pores; thin, patchy clay films on ped surfaces and in larger pores; common, fine fragments of basalt as large as ½ inch in diameter; slightly acid (pH 6.5); abrupt, wavy boundary.

B2—9 to 20 inches, brown to yellowish-brown (10YR 5/3 to 5/4) very stony heavy loam, dark brown to dark yellowish brown (10YR 4/3 to 10YR 3/4) when moist; moderate, medium, prismatic structure breaking to moderate, fine to medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; many roots; common, fine, tubular pores; thick, continuous clay films on prisms and blocks; many, fine fragments of basalt as large as ½ inch in diameter; neutral (pH 6.6); abrupt, wavy boundary.

Dr—20 inches +, basalt bedrock.

The surface layer ranges from loam to clay loam, and the subsoil from clay loam to heavy loam. In some places, the color is reddish brown. The depth to basalt bedrock averages only about 16 inches.

Small areas of associated soils are included. As much as 10 percent of this mapping unit is Rock outcrop and rubble land.

Runoff is slow to rapid. The hazard of water erosion is slight. The moisture-supplying capacity is low. Fertility is also low.

This soil is used only for grazing late in fall, in winter, and early in spring. Both the soil and the vegetation are readily damaged by overgrazing during moist seasons. *Capability unit VIIs–1; Moderate South Exposure range site.*

Lickskillet extremely stony loam, 40 to 70 percent south slopes (LsDS).—In places this soil has been altered by slides and by the movement of rocks down the slopes. The slopes are convex and are from 200 to 700 feet in length and from 200 feet to more than a mile in breadth. The dominant slope range is from 50 to 60 percent. Runoff is rapid, and water erosion is a moderate hazard.

As much as 10 percent of this mapping unit is other Lickskillet soils, and as much as 15 percent is Rock outcrop and rubble land. Rimrock and important springs are indicated on the detailed soil map by symbols.

This soil is used only for range in spring and in fall. Because of the very steep slopes and large number of stones and outcrops of rock, livestock do not graze the areas uniformly but tend to overgraze the more accessible areas, especially those at the tops and bottoms of slopes. Prolonged overgrazing may destroy the forage plants. *Capability unit VIIs–1; Steep South Exposure range site.*

Lickskillet extremely stony loam, 40 to 70 percent north slopes (LsDN).—This soil occurs on north-facing slopes and is fair in moisture-supplying capacity. The total acreage in the county is small. Small areas of other Lickskillet soils are included in this mapping unit. Outcrops of basalt and debris make up as much as 10 percent. Rimrock and the important springs are indicated on the detailed soil map by symbols.

This soil is used only for range. It cannot be grazed so early in spring as the Lickskillet soils on south-facing slopes. *Capability unit VIIs–1; Droughty Steep North Exposure range site.*

Nansene Series

Only one Nansene soil is mapped in the county. This soil occurs on very steep north-facing slopes along the John Day, Deschutes, and Columbia Rivers and along the large tributaries throughout the northern half of the county. It is dark colored and is uniform in texture. It has formed from loess, under native vegetation consisting chiefly of Idaho fescue and bluebunch wheatgrass.

The surface layer, which averages about 20 inches in thickness, is dark grayish-brown, neutral to slightly acid, soft very fine sandy loam, coarse silt loam, or silt loam. It has a weak platy structure that breaks to weak granular. Grass roots are abundant in this layer.

The subsoil, which is similar in texture to the surface layer, is dark brown to dark grayish brown, slightly hard, neutral, and weakly prismatic.

The substratum, which is also similar in texture to the surface layer, is dark brown, slightly acid, slightly hard, and massive. The depth to basalt averages about 3 feet but ranges from 2 to 6 feet.

This soil is somewhat excessively drained and is moderately permeable.

The Nansene soil is used only for range. It is associated with the Lickskillet and Starbuck soils, which are on southern exposures facing the Nansene soil, and with the Walla Walla and Ritzville soils, which are on billowy loessal plateaus. On many foot slopes, the Nansene soil is adjacent to the deeply dissected Sagemoor soils.

Nansene rocky silt loam, 35 to 70 percent slopes (NaD).—This soil occurs on very steep canyon walls and on breaks to rivers in the northern half of the county. Except for the foot slopes, which are concave, the slopes are slightly convex. The dominant slope is about 55 percent. In soil association 6, the slopes range from 200 to 700 feet in length; in other places, they commonly range from 100 to 300 feet.

Representative profile in native range, 60 percent north-facing slope, in SE¼SW¼ sec. 12, T. 1 N., R. 15 E.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) coarse silt loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure breaking to weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots abundant; many, fine, interstitial pores; pH 6.5; abrupt, wavy boundary.

A12—3 to 10 inches, dark grayish-brown (10YR 4/2) coarse silt loam, very dark brown (10YR 2/2) when moist; very weak, thick, platy structure breaking to very weak, medium, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots abundant; common, fine, interstitial pores; pH 6.6; clear, smooth boundary.

A13—10 to 20 inches, dark grayish-brown (10YR 4/2) coarse silt loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots abundant; many, fine, tubular pores; pH 6.6; clear, smooth boundary.

B—20 to 37 inches, dark-brown (10YR 4/3) coarse silt loam, very dark brown (10YR 2/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots abundant; many, fine, tubular pores; pH 6.6; clear, smooth boundary.

C—37 to 54 inches, dark brown (10YR 4/3) coarse silt loam, dark brown (10YR 3/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many roots; common, fine, tubular pores; few rock fragments; pH 6.5; abrupt, irregular boundary.
D—54 inches, basalt rubble.

The depth to basalt averages about 3 feet but ranges from 2 to 6 feet. Calcareous horizons are not common, except at a depth of more than 5 feet. Pieces of basalt, 1 inch or less in diameter, make up almost 5 percent of the soil material. Larger fragments, stones, and rocks are common throughout the profile and on the surface.

In many areas the loessal parent material has not covered the underlying basalt bedrock, and debris and outcrops of basalt are characteristic. Most of these areas are indicated on the detailed soil map by symbols. Large areas are mapped separately. In some places, especially along the Deschutes River, small springs seep from the hillsides the year around. If these springs were developed, this soil could be better utilized. Occasionally, this soil creeps or slips when wet, and loose basalt rolls down the slope.

Included in this mapping unit are some small areas of Lickskillet extremely stony loam, 40 to 70 percent south slopes, and of Starbuck extremely stony loam, 40 to 70 percent south slopes. As much as 15 percent is rock outcrop and rubble land.

The Nansene soil is susceptible to moderate erosion if the vegetation is sparse, and to accelerated erosion if the range is in poor condition. Surface runoff is medium if rainfall and snowmelt are normal, but rapid to very rapid if there are cloudbursts and chinook winds. Fertility is moderate, and the moisture-supplying capacity is fair to high.

This soil is used only for range. Reseeding is not practical, because of the steep slopes, stoniness, and outcrops of rock. In many places rimrock and rock slides are natural barriers to livestock. *Capability unit VIIs-1; Steep North Exposure range site.*

Pedigo Series

Only one Pedigo soil is mapped in Sherman County. This is a poorly drained, dark-colored, nearly level soil that occurs on a few of the wide bottom lands along streams in the southern part of the county. It has formed in alluvium derived from loess and volcanic ash that has been washed from the uplands. The native vegetation consists mainly of giant wildrye and saltgrass.

The surface layer, which extends to a depth of about 16 inches, is dark-brown to black, strongly calcareous, friable to firm, weak subangular blocky silt loam or silty clay loam that is strongly to moderately alkaline. Roots are abundant in this layer.

The subsoil, which averages 21 inches in depth, is very dark gray, strongly calcareous, firm, weak subangular blocky silty clay loam that is moderately alkaline. Roots are abundant but less so than in the surface layer.

The upper part of the substratum, to an average depth of about 35 inches, is dark gray when moist but otherwise is similar to the subsoil. The lower part is massive, dark-brown to gray fine sandy loam or loamy sand that contains few roots.

This soil is wet most or all of the year. It holds about 0.22 inch of available moisture per inch of depth. Natural drainage is poor, and permeability is slow.

The Pedigo soil is used mostly to grow hay and pasture plants. It is associated with soils of the uplands in the vicinity of Grass Valley and in Finnegan Canyon.

Pedigo silt loam (Pe).—This poorly drained soil occurs on flood plains, mainly in Finnegan Canyon and in the vicinity of Grass Valley. At Finnegan Canyon, an intracanyon basalt flow has caused the formation of a flood plain that is about 300 yards wide. This dike restricts the drainage of water from this soil.

Representative profile in a hayfield, ½ percent slope, 400 feet south of corral and 550 feet east of road, in SE¼SE¼ sec. 34, T. 3 S., R. 16 E.

A11—0 to 2 inches, dark-brown (10YR 3/3, moist) silt loam; weak, fine and very fine, subangular blocky structure; firm when moist, slightly sticky and slightly plastic when wet; roots abundant; few, fine, tubular pores; strongly alkaline (pH 8.8); strongly calcareous, no visible lime; abrupt, smooth boundary.
A12—2 to 7 inches, very dark brown (10YR 2/2, moist) silt loam; weak, fine and very fine, subangular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; roots abundant; few, fine, tubular pores; moderately alkaline (pH 8.4); strongly calcareous, no visible lime; clear, smooth boundary.
A13—7 to 16 inches, black (10YR 2/1, moist) silt loam; weak, medium, prismatic structure breaking to weak, fine, subangular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; roots abundant; few, fine, tubular pores; moderately alkaline (pH 8.4); strongly calcareous, no visible lime; clear, smooth boundary.
AC—16 to 21 inches, very dark gray (10YR 3/1, moist) silty clay loam; weak, fine, subangular blocky structure; firm when moist, sticky and plastic when wet; roots abundant; common, fine, tubular pores; moderately alkaline (pH 8.2); strongly calcareous, no visible lime; smooth boundary.
C—21 to 35 inches, dark-gray (10YR 4/1, moist) silty clay loam; weak, medium and coarse, subangular blocky structure; firm when moist, sticky and plastic when wet; roots abundant; common, fine, tubular pores; moderately alkaline (pH 8.2); strongly calcareous, no visible lime; abrupt, smooth boundary.
D1—35 to 56 inches, dark-brown (10YR 4/3, moist) fine sandy loam; massive; very friable when moist, nonsticky and nonplastic when wet; few roots; clear, smooth boundary.
D2—56 to 84 inches, gray (10YR 5/1, wet) loamy sand; massive; nonsticky and nonplastic when wet; few roots; many manganese dioxide concretions in uppermost part.

The surface layer ranges from silt loam to silty clay loam and, when moist, from dark brown to black.

Water drains slowly from the Pedigo soil, and some areas are ponded part of the time. Water erosion is only a slight hazard, but the drainageways have undercut their banks to some extent. The water table fluctuates; in spring it is at the surface, and in fall it is at a depth of about 48 inches. The moisture-supplying capacity is very high. Fertility is moderate. If the soil is worked when wet, it forms large clods or becomes puddled. *Capability unit IVw-1; Alkaline Bottom range site; hay and pasture group 5.*

Quincy Series

Only one Quincy soil is mapped in Sherman County. This is a somewhat excessively drained sandy soil that occurs in duned areas along the Columbia River. It is subject to severe wind erosion. The parent material consists of thick deposits of wind-laid or wind-distributed quartz and basalt sands. The native vegetation consisted chiefly of needlegrass and bluebunch wheatgrass.

The surface layer, which averages about 7 inches in thickness, is neutral, grayish-brown loamy fine sand that is weak platy to single grain. It is readily moved by wind if the vegetation is removed.

The substratum generally is immediately beneath the surface layer. To a depth of more than 60 inches, it is massive and contains few roots but otherwise is similar to the surface layer.

This soil holds about 0.08 inch of available moisture per inch of depth. Natural drainage is somewhat excessive, and permeability is very rapid.

The Quincy soil is used entirely for range. It is associated with the Walla Walla very fine sandy loams.

Quincy loamy fine sand, 0 to 20 percent slopes (QnB).—This soil occurs only along the Columbia River. It is of minor extent and is not important agriculturally.

Representative profile in native range, 5 percent slope, 90 feet south of U.S. Highway No. 30, and 330 feet east of road at Biggs road cut, SE¼SE¼ sec. 8, T. 2 N., R. 16 E.

A1—0 to 7 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark brown (10YR 4/3) when moist; weak, thick, platy structure breaking to single grain; loose when dry and moist, nonsticky and nonplastic when wet; roots plentiful; few, very fine, interstitial pores; pH 7.0; abrupt, smooth boundary.

C1—7 to 60 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few roots; very few, very fine, tubular pores; pH 7.2; gradual, smooth boundary.

C2—60 to 70 inches +, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic when wet; very few roots; very few, very fine, tubular pores; pH 7.2.

The surface layer ranges from 5 to 8 inches in thickness and from grayish brown to pale brown in color. In most places, the depth to stream-deposited gravel or basalt bedrock is more than 48 inches. On about half the acreage, some waterworn gravel occurs throughout the soil material. Free lime generally is lacking or is at a depth of more than 60 inches. About 10 percent of this mapping unit is Walla Walla very fine sandy loams, and as much as 5 percent is Dune land and Rock land.

Surface runoff is very slow on the Quincy soil, and water erosion is not a hazard. Wind erosion, however, is a severe hazard, particularly if the vegetation has been destroyed by fire. Most areas have been burned many times, and much of this acreage has been severely eroded by wind. The moisture-supplying capacity is low, and fertility is very low. The Qunicy soil is used for range or is idle. A considerable amount of the soil material has been used in highway construction. *Capability unit VIIe-1; Sand Hills range site.*

Ritzville Series

The Ritzville soils in Sherman County occur only in the area known locally as "Starvation Point." The annual precipitation in this area is 1 to 3 inches less than in other parts of the county.

These soils are uniformly textured silt loams that are underlain, commonly at a depth of 30 to 50 inches, by basalt bedrock or caliche. They have formed from loess on the gently sloping to steeply sloping uplands. The native vegetation consisted of bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue.

The surface layer, which extends to a depth of 6 to 10 inches, is pale brown to brown, neutral, soft, and weak granular.

The subsoil, which extends to a depth of about 30 inches or more, is slightly hard, neutral, weak prismatic, and a shade lighter colored than the surface layer.

The substratum is pale brown to very pale brown, slightly hard to hard, mildly alkaline to strongly alkaline, and weak prismatic to massive. Free lime occurs at a depth of 30 to 50 inches. The depth to basalt bedrock ranges from 38 inches to more than 60 inches.

These soils hold about 0.17 inch of available moisture per inch of depth. Natural drainage is good, and permeability is moderate.

The Ritzville soils are associated mainly with the Nansene and Starbuck soils. The Nansene soils occupy very steep north-facing canyon breaks; the Starbuck soils are adjacent to the Ritzville in nearly level areas and on very steep south-facing slopes.

The Ritzville soils are used mainly for growing wheat, but some small areas are used for range. About 10 percent of the acreage has been abandoned for cultivated crops and is now used for range or is idle.

Ritzville silt loam, 2 to 7 percent slopes (RiA).—This deep, brown soil occurs on slightly convex ridgetops. It is in soil association 4.

Representative profile in wheatfield, 2 percent north-facing slope, in SW¼SE¼ sec. 34, T. 1 N., R. 19 E., about 340 feet north of section-line road and 2,740 feet east of section corner.

A1p—0 to 7 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots abundant; common, fine, interstitial pores and tubular pores; few, fine fragments of basalt from 1 to 3 millimeters in diameter; neutral (pH 6.6); abrupt, smooth boundary.

B21—7 to 14 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; few, fine fragments of basalt from 1 to 3 millimeters in diameter; neutral (pH 6.8); gradual, smooth boundary.

B22—14 to 26 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; a sprinkling of gray color resulting from reduction, mainly on ped surfaces; few, fine fragments of basalt from 1 to 3 millimeters in diameter; neutral (pH 6.9); gradual, smooth boundary.

C1—26 to 42 inches, pale-brown (10YR 6/3) silt loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; few, fine fragments of basalt from 1 to 3 millimeters in diameter and very few from ½ to 1¼ inches in diameter; hard, noncalcareous nodules, with few, fine to medium, tubular pores; mildly alkaline (pH 7.8); abrupt, smooth boundary.

C2ca—42 to 45 inches, very pale brown (10YR 7/3) silt loam; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; very few roots; common, fine to medium, tubular pores; strongly calcareous, lime mainly disseminated; few, fine fragments of basalt from 1 to 3 millimeters in diameter; strongly alkaline (pH 8.6); abrupt, smooth boundary.

D—45 inches +, basalt bedrock, lime coated.

Ritzville silt loam, 2 to 7 percent slopes, ranges from 38 inches to more than 60 inches in depth. It generally is deepest on the gentle north-facing slopes. The surface layer normally is 7 or 8 inches thick. The depth to free lime ranges from 30 to 50 inches. Where the depth of the soil is more than 60 inches, fragments of basalt occur only in the 2 or 3 inches above basalt bedrock. As much as 10 percent of this mapping unit consists of other Ritzville soils.

Surface runoff is slow, and the hazard of water erosion is slight. The moisture-supplying capacity is good, fertility is moderate, and workability is very good. Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIs–1; Rolling Hills range site; hay and pasture group 3.*

Ritzville silt loam, 7 to 20 percent north slopes (RiBN).—This soil has a slightly darker colored surface layer than Ritzville silt loam, 2 to 7 percent slopes, and in most places the depth to bedrock is more than 48 inches. The moderately steep north-facing slopes are slightly convex. Most areas are long and narrow and are on the contour. Small areas of other Ritzville soils are included in this mapping unit.

Surface runoff is medium, and workability is good, but there are minor tillage and harvesting problems because of the slopes.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is low or medium, depending on the amount of precipitation. *Capability unit IIIe–3; Droughty North Exposure range site; hay and pasture group 2.*

Ritzville silt loam, moderately deep, 2 to 7 percent slopes (RtA).—The depth of this soil to basalt bedrock or caliche is only 26 to 38 inches. The surface layer averages about 6 inches in thickness. In a few places the substratum is as much as 7 inches thick, but in most places it is absent. Coarse fragments of sand and gravel occur throughout the profile. On about 10 percent of the acreage, pieces of caliche, ½ inch to 3 inches in size, are mixed in the soil material. As much as 10 percent of this mapping unit is other Ritzville soils or Starbuck very stony silt loam, 7 to 40 percent slopes.

Surface runoff is slow, and the hazard of water erosion is slight. The moisture-supplying capacity is only fair. Workability is good, but a few rocks on or near the surface interfere to some extent with tillage or harvesting.

Much of the acreage is used for growing wheat or barley, but about 30 percent is used for range or is idle. Because of the limited amount of rainfall and the shallowness of the soil, there is little or no response of wheat to nitrogen fertilizer. *Capability unit IVe–6; Droughty Rolling Hills range site; hay and pasture group 3.*

Ritzville silt loam, moderately deep, 7 to 20 percent north slopes (RtBN).—The depth of this soil to basalt or caliche is only 26 to 38 inches. The surface layer generally is a shade darker colored than that of Ritzville silt loam, 2 to 7 percent slopes. It averages from 6 to 8 inches in thickness. The subsoil is from 18 to 32 inches thick. Normally, there is no substratum. Coarse sand and gravel occur throughout the profile. On about 10 percent of the acreage, fragments of caliche, ½ inch to 3 inches in size, are mixed in the soil material.

This soil occurs where the gently sloping ridgetops break to moderately steep north-facing slopes. Most areas are long and narrow. Slopes are short. About 5 percent of this mapping unit is other Ritzville soils.

Surface runoff is medium, and the moisture-supplying capacity is fair. Tillage and harvesting are more difficult where the slope is more than 16 percent.

Most of the acreage is used for growing wheat. About 30 percent is used for range or has been abandoned. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe–7; Droughty North Exposure range site; hay and pasture group 3.*

Ritzville silt loam, moderately deep, 7 to 20 percent south slopes (RtBS).—The depth of this soil to basalt or caliche ranges from 26 to 38 inches, but commonly it is from 26 to 28 inches. The surface layer is 5 to 6 inches thick; the subsoil generally is about 20 inches thick; and the substratum, or C1 horizon, where it occurs, is only 1 to 3 inches thick. Coarse sand and gravel are more common in this soil than in any of the other Ritzville soils. On about 10 percent of the acreage, fragments of caliche, ½ inch to 3 inches in size, occur throughout the profile.

This soil occurs on slightly convex, moderately steep south-facing slopes, between the gently sloping Ritzville soils and the steeply sloping Starbuck soils. Most areas are long and narrow; slopes are short. As much as 5 percent of this mapping unit is other Ritzville soils, and as much as 5 percent is Starbuck very stony silt loam, 7 to 40 percent south slopes.

Surface runoff is medium, and the moisture-supplying capacity is low. There are some minor tillage and harvesting problems because of the slope and the small areas of included stony soils.

Most of the acreage is used for growing barley and wheat, but about 25 percent is used for range or is idle. There is little or no response of wheat to nitrogen fertilizer, because of the low rainfall, the droughty effects of southern exposures, and the shallowness of the soil material. *Capability unit IVe–6; Droughty Rolling Hills range site; hay and pasture group 3.*

Ritzville silt loam, moderately deep, 20 to 35 percent north slopes (RtCN).—The surface layer of this soil is from 8 to 10 inches thick. The depth to bedrock averages about 34 inches but ranges from 26 to 38 inches. Free lime either is lacking or is at a depth below 32 inches. Fragments of basalt are not common.

This soil occurs principally in narrow bands on steep, short north-facing slopes. The areas are between 5 and 30 acres in size. As much as 10 percent of this mapping unit is other Ritzville soils, and about 5 percent is Nansene rocky silt loam, 35 to 70 percent slopes.

Surface runoff is rapid, and the hazard of erosion is moderate. The moisture-supplying capacity is fair. Workability is poor because of the slope. Most of the acreage is in native range. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-1; Droughty North Exposure range site; hay and pasture group 2.*

Riverwash (Rv).—This miscellaneous land type occurs as narrow, irregular strips in the bends of stream channels along the Columbia, Deschutes, and John Day Rivers and along other large streams in the county. It is from 2 to 10 feet above the normal waterline. The strips are from 40 to 200 yards in width and consist of well-rounded sand, gravel, stones, and boulders, chiefly of basalt. The surface generally is uneven.

This land is subject to overflow when the water is high and is extremely droughty when the water is low. During each overflow, new deposits are received or some material is removed. Adjacent river sandbars are included in this mapping unit.

Some forage is produced, but generally this land has little value as range. *Capability unit VIIIs-1.*

Rock outcrop and rubble land (Rw).—This miscellaneous land type is widely scattered along the gorges of the Deschutes, John Day, and Columbia Rivers and along deep, tributary canyons. Some areas are as much as 400 acres in size. Very steep rocky slopes, steep severely eroded slopes, and basalt cliffs that have rocky foot slopes are characteristic of the area. The almost perpendicular cliffs range from a few feet to about 500 feet in height.

This land type is closely associated with the Nansene, Wrentham, Lickskillet, and Starbuck soils. Small areas of this land type are included in most of the mapping units in the county.

This land is so rough, so broken, and so rocky that it cannot be cultivated. Except for the small areas of included soils, it has no value as range. In many places, it forms a natural barrier to livestock. *Capability unit VIIIs-1.*

Rock land (Rx).—This miscellaneous land type occurs only along the Columbia River. These areas were previously part of the Columbia River channel but are now terraces above the river. Stream action has scoured holes in the basalt lava beds and deposited sand and waterworn gravel. Numerous large and small outcrops of bedrock protrude from a few inches to about 15 feet above the soil and occupy so much of the surface that cultivation is not possible. The soil consists mostly of sandy water-laid and wind-laid materials. It is light colored and contains little organic matter. The root zone is shallow, and the moisture-supplying capacity and natural fertility are low. The principal hazards are wind erosion and fire. Rock land is not subject to overflow.

This land generally is not suitable for grazing. Most areas are idle because they are not readily accessible to livestock. A few areas are used as gravel pits. *Capability unit VIIIs-1.*

Sagemoor Series

Only one Sagemoor soil is mapped in the county. This soil occurs at elevations of 600 to 1,000 feet, on terraces along the Deschutes and John Day Rivers, where the average annual temperature is slightly higher and the average annual precipitation is slightly lower than in most other parts of the county. This is a light-colored, deeply gullied silty soil that has formed in laminated silt loams and very fine sandy loams that contain much weathered granite and considerable basalt. The parent materials were deposited in old lake beds. The slope range is from gentle to steep. The native vegetation was mainly bluebunch wheatgrass and Sandberg bluegrass.

The surface layer, which extends to a depth of 2 to 4 inches, is pale-brown, neutral, soft, weak platy to granular silt loam or coarse silt loam.

The subsoil, which extends to a depth of about 9 inches, is similar in texture and in color to the surface layer but is slightly hard and weakly prismatic.

The underlying parent material is light-gray to very pale brown, slightly hard, massive silt loam, coarse silt loam, or very fine sandy loam that is thin platy at a depth of more than 24 inches. It is weakly calcareous in the upper part and strongly calcareous in the lower part. Where erosion has removed the uppermost few inches of the surface layer, the soil is calcareous at the surface.

The Sagemoor soil has good natural drainage and is moderately permeable. It is associated with the Lickskillet, Starbuck, Nansene, Wrentham, and Hermiston soils. On southern exposures, it is downslope from the Lickskillet or Starbuck soils; on northern exposures, it is downslope from the Nansene or Wrentham soils; and on bottom lands, it is upslope from the Hermiston soil and Sandy alluvial land.

The Sagemoor soil is used mostly for range. In most places, however, the range is in poor condition because livestock tend to gather in areas that are close to water.

Sagemoor silt loam, 5 to 40 percent slopes (SaC).—This pale-brown soil occurs only along the John Day and Deschutes Rivers, mostly in protected areas opposite the main cutting banks of streams. It is deeply gullied (fig. 22). The gullies probably developed when the original lake beds were lowered rapidly and the present swift-flowing rivers were formed.

Representative profile in native range, 25 percent east-facing slope; in SW¼SW¼ sec. 17, T. 1 S., R. 19 E.

A11—0 to 2 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure breaking to weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; abundant roots; many, fine, interstitial pores; neutral (pH 7.0); abrupt, smooth boundary.

A12—2 to 4 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, thick, platy structure breaking to weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; abundant roots; common, fine, continuous, tubular pores; neutral (pH 7.2); abrupt, smooth boundary.

AC—4 to 9 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; roots plentiful; common, fine, continuous, tubular pores; neutral (pH 7.2); clear, smooth boundary.

C1ca—9 to 24 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful;

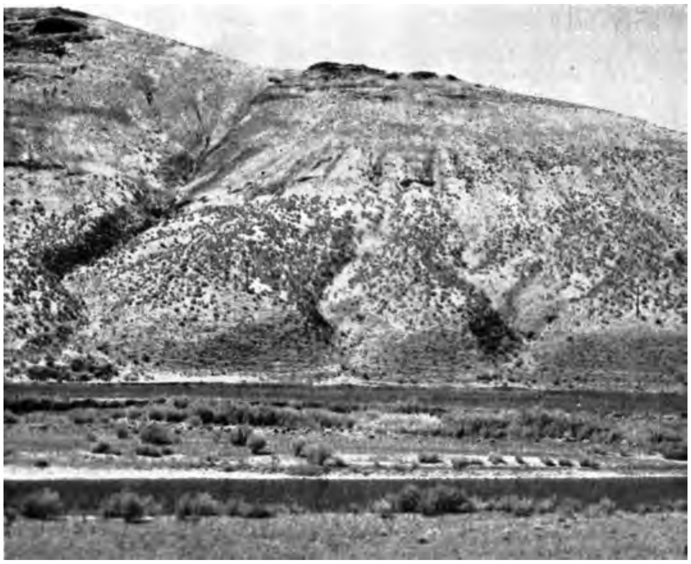

***Figure 22.*—The Sagemoor soil, middle ground, is on a deeply truncated terrace. Starbuck extremely stony silt loam, 40 to 70 percent south slopes, is upslope from the Sagemoor soil. In foreground, Riverwash adjoins the John Day River.**

few, fine, tubular pores; moderately alkaline (pH 8.0), mainly with disseminated lime; clear, smooth boundary.

C2ca—24 to 42 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; nearly moderate, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few roots; none to very few, fine, tubular pores; moderately alkaline (pH 8.2), mainly with disseminated lime; clear, smooth boundary.

C3ca—42 to 84 inches +, light-gray (10YR 7/2) silt loam, brown (10YR 4.5/3) when moist; moderate, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; very few roots; none to very few, fine, tubular pores; strongly alkaline (pH 8.5) with disseminated lime.

Typically, the depth to bedrock is more than 8 feet, but in many places where this soil is adjacent to the Lickskillet or Starbuck soils, the depth to bedrock is less than 4 feet. The texture ranges from silt loam to very fine sandy loam, both within the profile and from place to place. This soil is free of stones, rocks, or boulders, except in a few areas where debris has rolled from the slopes above. Small areas of other soils are included in this mapping unit.

The Sagemoor soil is low in moisture-supplying capacity and low in fertility. Surface runoff is slow to rapid, and the hazard of water erosion is slight to moderate. In a few places, both the surface layer and the subsoil have been removed by erosion and the calcareous substratum is exposed.

Because of the deep gullies and low rainfall, it is not feasible to grow wheat on this soil. All of the acreage is used for range, but in most places the range is in poor condition. Reseeding is difficult. *Capability unit VIe-1; Silty Terrace range site; hay and pasture group 3.*

Sandy alluvial land (Sd).—This miscellaneous land type consists of recent alluvium. The largest areas are along the John Day River.

Representative profile in native range, 2 percent slope, in SE¼SE¼NW¼ sec. 28, T. 3 S., R. 16 E.

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, dark brown (10YR 3/3) when moist; weak, very fine and fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; roots abundant; many, interstitial pores; neutral (pH 6.8); abrupt, smooth boundary.

AC1—7 to 16 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; roots plentiful; many, fine, interstitial pores; neutral (pH 6.9); clear, smooth boundary.

AC2—16 to 28 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; roots plentiful; many, fine, interstitial pores; strongly alkaline (pH 8.6), but only slightly calcareous, with disseminated lime; gradual, smooth boundary.

C1—28 to 47 inches, light-gray (10YR 7/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few roots; strongly alkaline (pH 8.5); strongly calcareous, with disseminated lime; clear, smooth boundary.

C2—47 to 63 inches, light-gray (10YR 7/2) fine sand, dark grayish brown (10YR 4/2) when moist; mottles of yellowish red (5 YR 5/6); single grain; loose when dry or moist; nonsticky and nonplastic when wet; few roots; moderately alkaline (pH 8.0); clear, smooth boundary.

C3—63 to 78 inches, grayish-brown (10YR 5/2) medium sand; mottles of yellowish red (5YR 5/6); single grain; loose when dry or moist, nonsticky and nonplastic when wet; neutral (pH 7.2); abrupt, smooth boundary.

D—78 inches +, volcanic ash; very fine sand; water table at 84 inches; neutral (pH 6.8).

Sandy alluvial land varies widely in texture within short distances. It consists of stratified layers of fine sandy loam, loamy fine sand, very fine sandy loam, loam, and silt loam. Water-rounded pebbles, mainly of basalt, commonly form stone lines or layers. Normally, the depth to bedrock or gravel is 78 inches or more, but in places it is as little as 15 inches.

The surface layer ranges from neutral to moderately alkaline in reaction and from dark grayish brown to light brownish gray in color.

Natural drainage is somewhat excessive; permeability is moderately rapid; and fertility is moderate to low. Surface runoff is slow, and the hazard of water erosion is slight, but in places erosion by streams is severe. Some areas along the John Day River are subject to overflow.

This soil holds about 0.08 to 0.1 inch of available moisture per inch of depth. It normally is low in moisture-supplying capacity. A few small areas, however, that are affected by seepage or that have a high water table are high in moisture-supplying capacity. Where the stream channel has cut deeply and lowered the water table, the soil is droughty.

This soil is used chiefly for range; a small acreage is used for growing wheat; other areas are irrigated for hay and pasture plants. The vegetation on most of the range consists mainly of annual grasses and brush. The response of wheat to nitrogen fertilizer is low. *Capability unit VIe-1; Well-Drained Bottom range site; hay and pasture group 3.*

Starbuck Series

The Starbuck series is made up of stony silt loams that have formed from loess mixed with gritty basalt material. These soils occur on gently sloping plateaus or on very steep south-facing ridges and canyon walls in the northern half of the county. The native vegetation consists mainly of bluebunch wheatgrass and Sandberg bluegrass.

The surface layer, which extends to a depth of 3 to 7 inches, is pale brown to brown, soft, and weak platy to granular. The subsoil, which extends to an average depth of 16 inches, is brown to yellowish brown, soft, and weak prismatic. Basalt bedrock occurs at a depth of 13 to 26 inches.

These soils are stony, very stony, or extremely stony. They are well drained to somewhat excessively drained and are moderately permeable.

The Starbuck soils occur in bands and in isolated areas, downslope from the deeper Walla Walla and Ritzville soils. They are at higher elevations than the Sagemoor soil, which is on foot slopes. In many places the Starbuck and Bakeoven soils occur in a complex pattern. The very stony and extremely stony phases of the Starbuck soils are similar to the Lickskillet soils.

Starbuck very stony silt loam, 7 to 40 percent south slopes (StCS).—This soil is widely scattered throughout the northern half of the county. It occurs on moderately steep to steep, convex south slopes that are from 100 to 400 feet in length. The dominant slope is about 25 percent.

Representative profile in native range, 20 percent southeast-facing slope, in NE¼NE¼ sec. 3, T. 1. S., R. 19 E., about 300 feet south of base line.

A11—0 to 3 inches, pale-brown (10YR 6/3) very stony silt loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure breaking to weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; 10 to 15 percent basalt gravel, cobbles, and stones, of which 2 to 5 percent is fine, rounded fragments from 1 to 5 millimeters in diameter; neutral (pH 7.0); abrupt, smooth boundary.

A12—3 to 7 inches, brown (10YR 5/3) very stony silt loam, dark brown (10YR 4/3) when moist; weak, medium, platy and weak, coarse, prismatic structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; common, fine, tubular pores; 10 to 15 percent basalt gravel, cobbles, and stones, of which 2 to 5 percent is fine, rounded fragments from 1 to 5 millimeters in diameter; neutral (pH 7.0); clear, smooth boundary.

AC—7 to 14 inches, brown to yellowish-brown (10YR 5/3 to 5/4) very stony silt loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, prismatic structure breaking to coarse and medium, subangular blocky structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; common, fine, tubular pores; 10 to 15 percent basalt gravel, cobbles, and stones, of which 2 to 5 percent is fine, rounded fragments from 1 to 5 millimeters in diameter; neutral (pH 7.0); abrupt, wavy boundary.

D—14 inches +, basalt bedrock.

The depth of this soil to basalt bedrock averages about 16 inches. Loose basalt rocks, ranging from $1/16$ inch to more than 10 inches in size, make up from 2 to 20 percent of the soil material. Typically, the entire solum is silt loam, but, in the northeastern part of the county, it commonly is very fine sandy loam.

Starbuck very stony silt loam, 7 to 40 percent south slopes, is adjacent to the deeper, nonstony Walla Walla and Ritzville soils, which are on ridgetops, and to the very steep, extremely stony Starbuck soil, which is on canyon breaks. Small areas of these associated soils make up as much as 10 percent of this mapping unit. As much as 2 percent is rock outcrop and rubble land.

Surface runoff is medium to rapid, and the erosion hazard is slight. Drainage is good to somewhat excessive, the moisture-supplying capacity is low, and fertility is low.

This soil is too stony and too droughty to be used for crops, and most areas are used for range. In most places the range is in poor condition. *Capability unit VIIs–1; Moderate South Exposure range site.*

Starbuck stony silt loam, 4 to 20 percent slopes (SrB).—This soil occurs mostly in the extreme eastern part of the county, in the area known locally as "Starvation Point." The total acreage is small.

This soil is associated with the Ritzville soils, small areas of which make up as much as 5 percent of this mapping unit. Small areas of other Starbuck soils are also included.

Drainage is good on this soil, and runoff is slow to medium. Most of the acreage is used for range, and most of the range is in poor condition. Reseeding is feasible in some places. *Capability unit VIe–1; Droughty Rolling Hills range site; hay and pasture group 3.*

Starbuck extremely stony silt loam, 40 to 70 percent south slopes (SvDS).—This soil occurs on very steep south-facing canyon breaks. The dominant slope is about 55 percent, and the slopes range from 100 to 700 feet in length. Typically, the texture is silt loam, but in association 1 it ranges from silt loam to very fine sandy loam. The depth to bedrock averages about 14 inches. Loose basalt rocks, ranging from 1/16 inch to 20 inches in diameter, make up from 10 to 20 percent of the soil material. Basalt rimrock, rock slides, and a few springs are characteristic of the areas. As much as 5 percent of this mapping unit is the Sagemoor, Lickskillet, Nansene, and other Starbuck soils, and as much as 10 percent is Rock outcrop and rubble land. The rocky areas are indicated on the detailed soil map by symbols.

This soil is not stable, and pieces of basalt frequently roll down the slopes. Surface runoff is rapid to very rapid, and the hazard of erosion is moderate. The moisture-supplying capacity is low, fertility is low, and drainage is somewhat excessive.

Most areas are used for grazing in spring and in fall. This soil could be better utilized for grazing if some of the larger springs were developed. Both the soil and the vegetation can be permanently damaged by overgrazing. *Capability unit VIIs–1; Steep South Exposure range site.*

Starbuck-Bakeoven complex, 2 to 20 percent slopes (SxB).—This complex consists of Starbuck silt loam and Bakeoven very stony loam, which occur together in such a complex pattern that it is not practical to map them separately. The Starbuck soil occupies from 40 to 80 percent of each area. In a few places the landform is typically biscuit scabland, but in most places the Starbuck soil does not form well-defined biscuits, or mounds. In all places, however, the deeper Starbuck soil occurs as the circular or elongated mounds, and the Bakeoven soil occurs as scabland between or around these mounds. The circular mounds are from 15 to 30 feet in diameter and are from 20 to 50 feet apart. The width of the elongated mounds varies, and the distance between them ranges from 5 feet to more than 100 feet.

The Starbuck soil averages about 16 inches in depth to basalt and is deepest in the center of the mounds. It contains numerous small fragments of basalt, 1 to 5 millimeters in size, but is less stony than Starbuck very stony silt loam, 7 to 40 percent south slopes. The Bakeoven soil contains more silty material than Bakeoven very stony loam, 2 to 20 percent slopes. It is described in detail under the subheading "Bakeoven Series."

This complex is widely scattered throughout the northern half of the county. It occurs chiefly on south-facing slopes, along intermittent field drainageways. The dominant slope is about 10 percent. The slopes range from 40 to 400 feet in length and average about 200 feet.

The soils in this complex are associated with the deeper Walla Walla and Ritzville soils, which are on ridgetops. Small areas of these associated soils make up as much as 5 percent of this mapping unit. As much as 10 percent is Starbuck very stony silt loam, 7 to 40 percent south slopes.

Where this complex is associated with the Ritzville soils, surface runoff is medium and the hazard of water erosion is slight; where it is associated with the Walla Walla soils, runoff is slow to rapid and the hazard of water erosion is moderate.

The Starbuck soil has a shallow root zone, and it is low in both fertility and moisture-supplying capacity. The Bakeoven soil has a very shallow root zone, and it is very low in both fertility and moisture-supplying capacity.

All of the acreage is used for range or is idle. The amount of forage produced in an area depends primarily on the percentage of Starbuck soil in the area. *Capability unit VIIs-1; Droughty Biscuit-Scabland Complex range site.*

Walla Walla Series

The Walla Walla soils have formed from loess, under native vegetation consisting mainly of bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. These soils are extensive in the northern half of Sherman County. Most areas are smooth and gently sloping; smaller areas are moderately steep to steep and occur on both north-facing and south-facing slopes.

The surface layer, which ranges from 7 to 18 inches in thickness, is grayish-brown, smooth, floury silt loam, coarse silt loam, or very fine sandy loam.

The subsoil, which ranges from 18 inches to more than 60 inches in depth, is a shade lighter colored than the surface layer but otherwise similar.

The silt loams hold 0.18 inch of available moisture per inch of depth; the coarse silt loams hold 0.13 inch per inch of depth; and the very fine sandy loams, 0.12 inch per inch of depth.

The Walla Walla soils are used almost entirely for growing wheat and barley. They are associated mainly with the Starbuck, Bakeoven, Nansene, and Hermiston soils.

Walla Walla silt loam, very deep, 3 to 7 percent slopes (WaA).—This soil (fig. 23) is extensive and occurs in large areas. In most places it is on parallel, smooth-topped ridges that range in width from 100 feet to almost a mile. The dominant slope range is 4 to 5 percent. This soil and the ten soils that follow are in soil association 3.

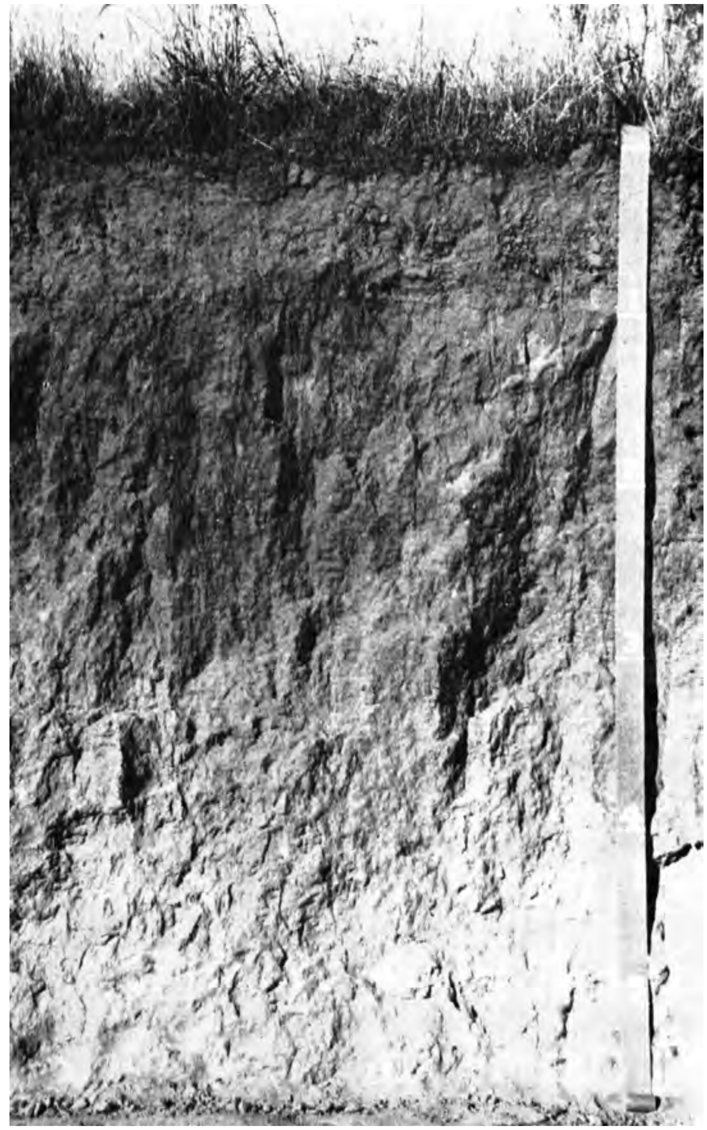

***Figure 23.*—Profile of Walla Walla silt loam, very deep, 3 to 7 percent slopes. The dark-colored surface layer is about 1 foot thick. (Part of the surface layer has recently been deposited by wind from the adjacent field to the west.) The subsoil, which extends to a depth of about 4 feet, is a shade lighter colored than the surface layer and is weak prismatic. The substratum is light colored and has no visible structure.**

Representative profile in wheatfield, 7 to 8 percent north-facing slope, 85 feet west of road curve, 15 feet north of section line, SE¼SW¼ sec. 25, T. 1 N., R. 16 E. Profile No. 9 in the section "Laboratory Data."

A1p—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure breaking to weak, fine to medium, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

A1pm—7 to 8½ inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, thick, platy structure; slightly hard when dry, firm when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, tubular pores; neutral (pH 6.7); abrupt, smooth boundary.

A12—8½ to 17 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, tubular pores; no clay films; neutral (pH 6.8); clear, wavy boundary.

B21—17 to 25 inches, grayish-brown (10YR 5/2) silt loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, medium to coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, tubular pores; neutral (pH 6.9); gradual, wavy boundary.

B22—25 to 34 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, tubular pores; neutral (pH 6.9); gradual, wavy boundary.

C1—34 to 50 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots abundant; many, very fine and fine, tubular pores; few, firm nodules, ¼ to ¾ inch in diameter; a sprinkling of gray color; mildly alkaline (pH 7.4); gradual, wavy boundary.

C2—50 to 66 inches, brown (10YR 5/3) coarse silt loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure; slightly hard to hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; some firm nodules, ¼ to ¾ inch in diameter; a sprinkling of gray color; mildly alkaline (pH 7.5); gradual, wavy boundary.

C3—66 to 76 inches, brown (10YR 5/3) coarse silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard to hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many fine pores; many firm nodules, ¼ to ¾ inch in diameter; mildly alkaline (pH 7.7); gradual, wavy boundary.

C4ca—76 to 106 inches, brown (10YR 5/3) coarse silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard to hard when dry, friable to firm when moist, slightly sticky and slightly plastic when wet; few roots; few, very fine pores; slightly calcareous with mycelial lime along root channels; many firm nodules, ¼ to ¾ inch in diameter; moderately alkaline (pH 8.0); gradual, wavy boundary.

C5—106 to 116 inches +, light yellowish-brown (10YR 6/4) coarse silt loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few to no roots; few very fine pores; moderately alkaline (pH 7.9).

The depth to free lime ranges from 60 to 80 inches. Nodules as much as 1 inch in diameter are common at a depth of 60 to 80 inches. The nodules commonly are calcareous on the outside and noncalcareous on the inside. In cultivated areas a crust forms on the surface, and under the crust is 1 to 3 inches of soil that contains numerous vesicles, or voids. This crusted surface drastically restricts the infiltration of rainfall. When dry, it resembles a cracked pavement (fig. 24). About 10 percent of this mapping unit consists of the more shallow or more sloping Walla Walla soils.

Walla Walla silt loam, very deep, 3 to 7 percent slopes, can be worked throughout a fairly wide range of moisture conditions. Surface runoff is slow, and the hazard of water erosion is slight. Fertility and moisture-supplying capacity are high.

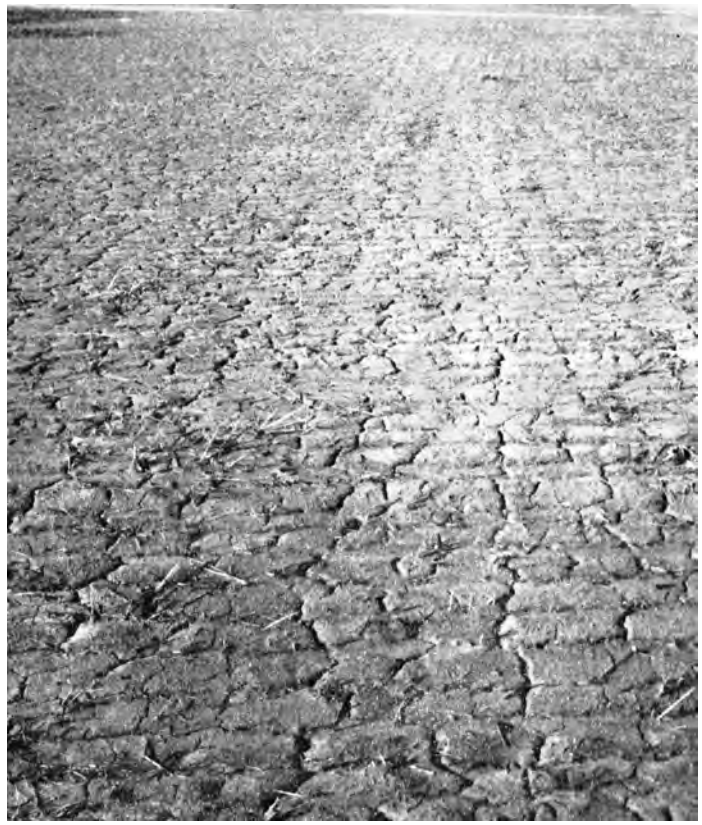

Figure 24.—View of Walla Walla silt loam, very deep, 3 to 7 percent slopes, that has been plowed with a moldboard plow and seeded with a 6-inch double disk drill, which is common practice in many areas. A crust has formed on the surface, and large cracks have developed.

Much of the acreage is used for growing wheat. Yields are as high as those on any other soil in the county. The response of wheat to nitrogen fertilizer is high. *Capability unit IIc–1; Rolling Hills range site; hay and pasture group 1.*

Walla Walla silt loam, very deep, 7 to 20 percent north slopes (WaBN).—This soil occurs mainly on north-facing slopes where the broad ridgetops break to the draws or canyons. Typically, the surface is smooth and is broken only by scattered drainage swales that, in most places, can be crossed by machinery. The surface layer generally is a shade darker colored and is slightly thicker than that of Walla Walla silt loam, very deep, 3 to 7 percent slopes. In most places free lime is at a depth of more than 70 inches. About 10 percent of this mapping unit is other Walla Walla silt loams.

This soil is easily worked, except on the steeper part of slopes. Surface runoff is medium, and the hazard of water erosion is moderate.

Most of the acreage is used for growing wheat, and yields are well above average for the county. The response of wheat to nitrogen fertilizer is high. *Capability unit IIIe–1; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, very deep, 7 to 20 percent south slopes (WaBS).—The surface layer of this soil commonly is slightly lighter colored and 2 to 4 inches thinner than that of Walla Walla silt loam, very deep, 3 to 7 percent slopes. Free lime generally accumulates at a depth of 50 to 60 inches.

Most of this soil is on the south-facing slopes of ridges. Typically, the slope is 3 to 5 percent less than that of the soils on the north-facing slopes of the same ridge, and the drainageways tend to be more shallow. In some places the soil is stony. As much as 5 percent of this mapping unit is other Walla Walla silt loams.

Runoff is medium, and the hazard of water erosion is moderate but somewhat less serious than on the north-facing slopes. The moisture-supplying capacity is good. Workability and tilth generally are good, but tillage operations are difficult on slopes of more than 16 percent.

Most of the acreage is used for wheat. In years when the precipitation is average or below average, yields are less than on soils on ridgetops or on north-facing slopes. When the precipitation is above average, yields may be higher than on these soils. Similarly, the response of wheat to nitrogen fertilizer fluctuates from medium to high, depending on the amount of precipitation. *Capability unit IIIe-2; Rolling Hills range site; hay and pasture group 2.*

Walla Walla silt loam, very deep, 20 to 35 percent north slopes (WaCN).—This soil typically has a dark grayish-brown surface layer, and generally there is an accumulation of free lime at a depth of more than 70 inches. It occurs in narrow bands downslope from less sloping Walla Walla soils and in many places upslope from the very steep Nansene soil. It is of small extent, and the areas are between 5 and 30 acres in size.

Where the length of the slope is less than 200 feet and the gradient is less than 30 percent, this soil generally is cultivated. Where the slope is longer and steeper, the soil is used mainly for range. About 5 percent of this mapping unit is other Walla Walla silt loams, and about 5 percent is Nansene rocky silt loam, 35 to 70 percent slopes.

This soil retains frost later and remains wet longer in spring than other Walla Walla silt loams. Because of the slope, it is unstable in places and tends to creep when wet. Workability is poor, surface runoff is rapid, and the hazard of water erosion is severe.

All of the acreage is used for range or for growing wheat. Yields of forage are high if the range is in good condition. Yields of wheat generally are well above the average for the county. The response of wheat to nitrogen fertilizer is high. Because of the high susceptibility of this soil to erosion, some areas that are cultivated should be converted to range, and others need a grass-legume rotation. *Capability unit IIIe-1; Moderate North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, deep, 3 to 7 percent slopes (WbA).—This soil ranges from 38 to 60 inches in depth to basalt or caliche. In places lime occurs in the profile at a depth of 55 to 60 inches.

This soil occurs on broad, smooth ridgetops. Small areas of other Walla Walla silt loams make up as much as 10 percent of this mapping unit.

The moisture-supplying capacity of this soil is high, and most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIc-v; Rolling Hills range site; hay and pasture group 1.*

Walla Walla silt loam, deep, 7 to 20 percent north slopes (WbBN).—This soil ranges from 38 to 60 inches in depth. In places the surface layer is 1 to 3 inches thicker and a shade darker colored than that of Walla Walla silt loam, very deep, 3 to 7 percent slopes. A layer of accumulated lime is not common.

Most of this soil is on north-facing slopes. Its position on the landscape is similar to that of Walla Walla silt loam, very deep, 7 to 20 percent north slopes. As much as 10 percent of this mapping unit consists of other Walla Walla silt loams.

Surface runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is high, and workability and tilth generally are good, but tillage operations are difficult on slopes of more than 16 percent.

This soil is used principally for growing wheat. Yields are good but generally are slightly lower than on the very deep Walla Walla soils that have the same slope range and same exposure. The response of wheat to nitrogen fertilizer is medium to high. *Capability unit IIIe-1; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, deep, 7 to 20 percent south slopes (WbBS).—This soil ranges from 38 to 60 inches in depth to basalt or caliche. It is slightly lighter colored than Walla Walla silt loam, very deep, 3 to 7 percent slopes, and the surface layer is 2 to 4 inches thinner. An accumulation of free lime at a depth of about 48 inches is common.

Most areas are on south-facing slopes and occur as long contour strips at the edges of broad, gently sloping ridgetops. The slope commonly is as much as 5 percent less than that of similar soils on north-facing slopes. In some areas field drainageways are shallow and stony and cannot be crossed with farm machinery.

Surface runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is good. Workability and tilth generally are good, but tillage operations are difficult on slopes of more than 16 percent.

Most of the acreage is used for growing wheat. Wheat yields vary significantly and on the average are less than those obtained from similar soils on north-facing slopes. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe-2; Rolling Hills range site; hay and pasture group 2.*

Walla Walla silt loam, moderately deep, 3 to 7 percent slopes (WcA).—The profile of this soil is similar to that of the representative profile, except that the depth to basalt bedrock or caliche is only 18 to 38 inches. The surface layer varies in thickness but averages about 13 inches. In most places there is little or no accumulation of lime. Where lime has accumulated, it is at a depth of more than 33 inches, is finely segregated, and is evenly distributed. Small fragments of basalt, 1/8 to 1/2 inch in size, are mixed in the soil material. In a few places where the soil is underlain by caliche, pieces of caliche of various sizes are on the surface and through the profile.

This soil is not extensive, but it is scattered throughout nearly all parts of soil association 3. It occurs on smooth, gently sloping ridges. The dominant slope is 4 or 5 percent. About 10 percent of this mapping unit consists of other Walla Walla silt loams.

This soil is easy to cultivate, and except for a few stony, shallow drainageways, there are no tillage problems. Its relative shallowness, however, limits both the supply of nutrients and the amount of water that can be stored for the use of plants. Fertility is moderate.

Most of the acreage is used for growing wheat. A few areas have been seeded to improved perennial grasses. Wheat yields vary with the depth of the soil but are below average for the county. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIs-1; Rolling Hills range site; hay and pasture group 3.*

Walla Walla silt loam, moderately deep, 7 to 20 percent north slopes (WcBN).—This soil ranges from 18 to 38 inches in depth. Small fragments of basalt, 1/8 to 1/2 inch in size, are scattered throughout the soil material. In most areas, there is no accumulation of free lime.

This soil is not extensive. It occurs on breaks at the edge of ridges, generally near large drainageways. About 10 percent of this mapping unit is other Walla Walla silt loams.

Surface runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is good, and fertility is moderate. Workability and tilth generally are good, but field drainageways are shallow and stony and, in places, cannot be crossed with farm machinery. Tillage operations are difficult on slopes of more than 16 percent.

This soil is used mainly for growing wheat. Yields are about average for the county and normally are slightly higher than those on Walla Walla silt loam, moderately deep, 3 to 7 percent slopes. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIe-3; Droughty North Exposure range site; hay and pasture group 2.*

Walla Walla silt loam, moderately deep, 7 to 20 percent south slopes (WcBS).—This soil ranges from 18 to 38 inches in depth and averages about 24 inches. The surface layer is lighter colored and 2 to 6 inches thinner than that of other Walla Walla silt loams. In a few areas lime has accumulated at a depth of more than 2 feet. Many small fragments of basalt, 1/8 to 1/2 inch in size, are mixed in the soil material, especially where the depth to basalt is 30 inches or less. Where the soil is underlain by caliche, pieces of caliche are on the surface and scattered throughout the profile.

This soil is more extensive than the other moderately deep Walla Walla silt loams. It is downslope from gently sloping Walla Walla soils and, in many places, upslope from the Starbuck-Bakeoven complex. Field drainageways generally are shallow and stony and are difficult to cross with farm equipment. About 10 percent of this mapping unit consists of other Walla Walla soils and Starbuck soils.

Surface runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is only fair; fertility is moderate; and, except for the shallow, stony drainageways, workability and tilth are good. Tillage operations are difficult on slopes of more than 16 percent.

This soil is used for growing wheat and for range. Wheat yields are well below average for the county. The returns on many of the shallower soils probably would be higher if these areas were seeded to improved perennial grasses and legumes and used for range. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-2; Droughty Rolling Hills range site; hay and pasture group 3.*

Walla Walla silt loam, moderately deep, 20 to 35 percent north slopes (WcCN).—This soil occurs in narrow bands, chiefly along the large drainageways of Barnum and Grass Valley Canyons. The areas are between 5 and 40 acres in size. The depth to basalt ranges from 18 to 38 inches. The surface layer is a shade darker colored than that of Walla Walla silt loam, very deep, 3 to 7 percent slopes, and numerous fragments of basalt, 1/8 to 1/2 inch in size, are scattered throughout the soil profile. A layer of free lime is not common.

Where the length of the slope is less than 200 feet and the gradient is less than 30 percent, this soil generally is cultivated. Where the slope is longer and steeper, the soil is used mainly for range. About 5 percent of this mapping unit is other Walla Walla silt loams, and as much as 5 percent is Nansene rocky silt loam, 35 to 70 percent slopes.

This soil is difficult to work. It retains frost later and remains wet longer in spring than the less sloping Walla Walla silt loams. Because of the slope, it is unstable in places and tends to creep when wet. Surface runoff is rapid, and the hazard of water erosion is severe. The moisture-supplying capacity is good.

Most of the acreage is used for range. Only about 15 percent is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-1; Moderate North Exposure range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes (WdA).—This soil occurs on smooth, convex ridges in soil association 2. The topography is billowy and rolling. Toward the east, the topography is less rolling, and the individual areas are larger. About 10 percent of this mapping unit is other Walla Walla silt loams that have a coarse solum.

Representative profile in wheatfield, 3 percent slope, 50 feet west of county road, NW1/4NW1/4 sec. 22, T. 2 N., R. 17 E. Profile No. 11 in the section "Laboratory Data."

A1p—0 to 8 inches, grayish-brown (10YR 5/2) coarse silt loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many very fine pores; many very fine vesicles in uppermost inch; slightly acid (pH 6.4); abrupt, smooth boundary.

A1pm—8 to 10 inches, grayish-brown (10YR 5/2) coarse silt loam, very dark brown (10YR 2/2) when moist; moderate, medium to coarse, platy plowpan breaking to weak, fine, granular structure; hard when dry, very friable to friable when moist, slightly sticky and slightly plastic when wet; abundant roots; moderate number of very fine pores; neutral (pH 6.6); abrupt, smooth boundary.

A12—10 to 18 inches, grayish-brown (10YR 5/2) coarse silt loam, very dark grayish brown (10YR 3/2) when moist; very weak, coarse, prismatic structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many very fine pores; neutral (pH 6.9); clear, wavy boundary.

B2—18 to 32 inches, yellowish-brown (10 YR 5/4) coarse silt loam, dark yellowish brown (10YR 4/4) when moist; very weak, coarse, prismatic structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many very fine pores; neutral (pH 7.0); clear, wavy boundary.

C1—32 to 49 inches, brown (10YR 5/3) coarse silt loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure to massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many very fine pores; a sprinkling of gray color; neutral (pH 7.2); clear, wavy boundary.

C2ca—49 to 63 inches, light brownish-gray (10YR 6/2) coarse silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many very fine pores; weakly calcareous with mycelial lime in some root channels; moderately alkaline (pH 8.0); gradual, wavy boundary.

C3ca—63 to 79 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many very fine pores; slightly calcareous with slightly more mycelial lime in root channels than in C2ca horizon; few, firm nodules, ¼ to ¾ inch in diameter; moderately alkaline (pH 8.2); clear, wavy boundary.

C4ca—79 to 103 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark brown (10YR 4/3) when moist; massive; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; no roots; many very fine pores; moderately calcareous; lime in mycelial form; many very firm nodules, ¼ to ¾ inch in diameter; moderately alkaline (pH 8.4); abrupt, wavy boundary.

C5ca—103 to 110 inches, coarse silt loam; massive; very hard when dry, extremely firm when moist, slightly sticky and slightly plastic when wet; strongly calcareous; strongly alkaline (pH 8.6).

This soil is mainly coarse silt loam, but in a few places it is very fine sandy loam. The surface layer ranges from dark grayish brown to grayish brown in color and from 12 to 19 inches in thickness. The depth to accumulated lime varies. In the western part of soil association 2, where the annual precipitation is highest, it typically is more than 50 inches; in the eastern part, it ranges from 36 to 55 inches. In cultivated areas or where the range is in poor condition, a crust forms on the surface, but it is much weaker than the crust that forms on typical Walla Walla silt loams.

Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes, is slightly to highly susceptible to wind erosion, especially in dry years. Considerable wind drifting has occurred in many areas. Surface runoff is slow, and the hazard of water erosion is slight.

This soil holds about 0.13 inch of water per inch of soil depth. Permeability is moderately rapid, the moisture-supplying capacity is high, fertility is high, and tilth and workability are very good. Tillage can be undertaken throughout a wide range of moisture conditions, but minimum tillage during dry periods will reduce wind damage. Tillage operations generally begin late in winter.

This soil is used almost entirely for growing wheat. Yields are less than those in the Locust Grove area and in the vicinity of Moro, but they are above average for the county. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe-4; Rolling Hills range site; hay and pasture group 1.*

Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent north slopes (WdBN).—The surface layer of this soil is slightly darker colored and 2 to 4 inches thicker than that of Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes. The depth to free lime is 6 to 12 inches greater.

This soil occurs mainly on north-facing slopes. The surface is smooth and convex and is broken only by a few drainage swales. As much as 10 percent of this mapping unit is other Walla Walla soils that have a coarse solum.

Surface runoff is medium to rapid. The hazard of erosion, especially from wind action, is moderate. Tilth is very good, and workability is good. Tillage can be undertaken throughout a wide range of moisture conditions except where the slope is more than 16 percent. Accelerated wind drifting may result if the soil is tilled when dry.

Most of the acreage is used for growing wheat, and yields are above average for the county. The response of wheat to nitrogen fertilizer is medium to high. *Capability unit IIIe-5; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, coarse solum, very deep, 7 to 20 percent south slopes (WdBS).—The surface layer of this soil is a shade lighter colored and 2 to 4 inches thinner than that of Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes, and the depth to free lime generally is 4 to 8 inches less.

This soil occurs on the smooth, moderately steep south-facing slopes of ridge crests. Small areas of other Walla Walla soils that have a coarse solum are included.

This soil has good moisture-supplying capacity, but compared with soils on ridgetops and on north-facing slopes, it is somewhat droughty. Tilth is very good and workability is good. Surface runoff is medium, and the hazard of water erosion is moderate. Wind erosion is the principal management problem. Minimum tillage when the soil is dry will reduce wind damage.

Most of the acreage is used for growing wheat. Yields are good in years of above average precipitation and low in dry years. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe-5; Rolling Hills range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent north slopes (WdCN).—This soil occurs in narrow bands between ridgetops and large drainageways. The slopes are smooth and convex, and there are few outcrops of basalt. The surface layer is dark grayish brown, and the depth to free lime commonly is more than 60 inches. The areas are between 5 and 35 acres in size. Small inclusions of other Walla Walla soils that have a coarse solum make up less than 5 percent of this mapping unit, and small areas of the very steep Nansene soil make up as much as 5 percent.

Surface runoff is rapid, and the hazard of both water and wind erosion is moderate to severe. The moisture-supplying capacity is high, but workability is poor because of the steep slopes.

Many areas that have a slope range of 20 to 30 percent are used for growing wheat, but some areas have been abandoned and are idle or are used for range. The response of wheat to nitrogen fertilizer is high. *Capability unit IIIe-5; Moderate North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, coarse solum, very deep, 20 to 35 percent south slopes (WdCS).—The surface layer of this soil ranges from grayish brown to brown in color and from 8 to 13 inches in thickness. In most places free lime has accumulated at a depth of about 44 inches.

This soil occurs mainly on south-facing slopes, in narrow strips downslope from less sloping Walla Walla soils that have a coarse solum. The areas are between 5 and 25 acres in size. As much as 10 percent of this mapping unit is Starbuck soils and other Walla Walla soils that have a coarse solum.

This soil has rapid runoff and is moderately to highly susceptible to erosion. It is especially susceptible to wind drifting during dry years. The moisture-supplying capacity is good, but workability is poor because of the steep slopes.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe–3; Moderate South Exposure range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, deep, 3 to 7 percent slopes (WeA).—This soil ranges from 38 to 60 inches in depth and typically is underlain by caliche. It occurs mainly in the eastern part of soil association 2. Included in this mapping unit are small areas of other Walla Walla soils that have a coarse solum.

The moisture-supplying capacity is good; tilth is very good; and workability is very good throughout a wide range of moisture conditions.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIc–1; Rolling Hills range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, deep, 7 to 20 percent north slopes (WeBN).—This soil ranges from 38 to 60 inches in depth. The surface layer is a shade darker colored and 2 to 4 inches thicker than that of Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes. The depth to free lime is about 6 inches more, and in some places there is no layer of lime accumulation.

This soil is on smooth, convex, moderately steep north-facing slopes. Included are small areas of other Walla Walla soils that have a coarse solum.

Surface runoff is medium to rapid, and the hazard of water erosion is moderate. Wind erosion is also a hazard if the surface layer is dry and is without an adequate cover of residue or grass. The moisture-supplying capacity is high, and tilth is very good. Workability is good except on slopes of more than 16 percent. As the slope becomes steeper, tillage operations become increasingly more difficult.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe–5; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, coarse solum, deep, 7 to 20 percent south slopes (WeBS).—This soil occurs on smooth, convex, moderately steep south-facing slopes. It ranges from 38 to 60 inches in depth. The surface layer generally is 2 to 4 inches thinner and slightly lighter colored than that of Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes, and the depth to free lime is about 4 to 8 inches less. In some places small fragments of basalt are mixed in the soil material. About 10 percent of this mapping unit is other Walla Walla soils that have a coarse solum.

Surface runoff is medium, and the hazard of both wind and water erosion is moderate. The moisture-supplying capacity is good; tilth is very good; and workability is good except on slopes of more than 16 percent.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIe–6; Rolling Hills range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, deep, 20 to 35 percent north slopes (WeCN).—This soil occurs in long, narrow bands between the ridgetops and large drainageways. Except for a few outcrops of bedrock, the slopes are convex and smooth. The depth to basalt or caliche ranges from 38 to 60 inches. The surface layer is dark grayish brown. Commonly, there is no accumulation of lime in the profile.

Individual areas of this soil are between 5 and 25 acres in size. Small areas of Nansene rocky silt loam, 35 to 70 percent slopes, and of other Walla Walla soils that have a coarse solum are included in this mapping unit.

Surface runoff is rapid, and the hazard of both wind and water erosion is moderate to severe. Workability is poor because of the steep slopes.

Most of the acreage is used for range, but about 20 percent is used for growing wheat. The response of wheat to nitrogen fertilizer is medium to high. *Capability unit IIIe–5; Moderate North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, coarse solum, deep, 20 to 35 percent south slopes (WeCS).—This soil ranges from 38 to 60 inches in depth to basalt or caliche. The surface layer is 3 to 5 inches thinner and is lighter colored than that of Walla Walla silt loam, coarse solum, very deep, 3 to 7 percent slopes, and the depth to free lime is about 4 to 8 inches less.

This soil occurs in narrow bands on smooth, convex, steep south-facing slopes. The areas are between 5 and 30 acres in size. Included are small areas of Starbuck soils and other Walla Walla soils that have a coarse solum.

Surface runoff is rapid, and the hazard of both wind and water erosion is moderate to severe. The moisture-supplying capacity is good. Tilth is good, but workability is poor because of the steep slopes.

Most of the acreage is used for growing barley and wheat. About 20 percent is used for range. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe–3; Moderate South Exposure range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes (WgA).—This soil occurs on broad, smooth ridges and on gently sloping swales in all parts of association 2, but it is most extensive in the eastern part. The surface layer is from 10 to 14 inches thick. The depth to caliche or basalt ranges from 18 to 38 inches (fig. 25). Where the soil is underlain by caliche, lime carbonate occurs at various depths, and pieces of caliche are mixed in the soil material. Where the sol is underlain by basalt, small fragments of basalt, ⅛ to ½ inch in size, are scattered throughout the profile. As much as 10 percent of this mapping unit is other Walla Walla soils that have a coarse solum.

During dry periods, many areas of this soil have been subjected to moderate or severe wind erosion. Tilth and workability generally are good, although there are some stones and outcrops of caliche. The moisture-supplying capacity is only fair, and fertility is moderate.

This soil is used primarily for growing wheat. It normally is somewhat droughty, and yields are below average

Figure 25.—Profile of Walla Walla silt loam, coarse solum, moderately deep, 3 to 7 percent slopes. The dark-colored, weakly developed surface layer is about 1 foot thick; the lighter colored, prismatic subsoil extends to a depth of almost 3 feet and is underlain by hard, white caliche.

for the county. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe–7; Rolling Hills range site; hay and pasture group 3.*

Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent north slopes (WgBN).—This soil occurs on smooth, slightly convex, moderately steep north-facing slopes. It ranges from 18 to 38 inches in depth. Where it is underlain by caliche, pieces of caliche are common throughout the profile. Where it is underlain by basalt, basalt fragments, 1/8 to 1/2 inch in size, generally are mixed in the soil material. The total acreage is small, and the areas are between 10 and 40 acres in size. Small areas of other Walla Walla soils that have a coarse solum are included in this mapping unit.

Surface runoff is medium, and the hazard of both wind and water erosion is moderate. The moisture-supplying capacity is good, principally because of the northern exposure. Tilth and workability are good, except where the slope is more than 16 percent.

Most of the acreage is used for range. About 30 percent is used for growing wheat and barley. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIe–6; Droughty North Exposure range site; hay and pasture group 2.*

Walla Walla silt loam, coarse solum, moderately deep, 7 to 20 percent south slopes (WgBS).—This soil occurs as narrow bands, mainly on south-facing slopes below gently sloping ridges. It ranges from grayish brown to brown in color and from 8 to 12 inches in depth. Where it is underlain by basalt, small fragments of basalt, 1/8 to 1/2 inch in size, are mixed in the soil material. Where it is underlain by caliche, pieces of caliche, which vary in size, commonly occur on the surface and throughout the profile. Typically, the soil is calcareous only where it is underlain by caliche. About 5 percent of this mapping unit is other Walla Walla soils that have a coarse solum.

This soil is low in moisture-supplying capacity. Surface runoff is medium, and the hazard of both wind and water erosion is moderate. Fertility is moderate, but tilth and workability are only fair because of small stony inclusions and outcrops of caliche.

Most of the acreage is used for growing wheat. Yields generally are well below average for the county. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe–4; Droughty Rolling Hills range site; hay and pasture group 3.*

Walla Walla silt loam, coarse solum, moderately deep, 20 to 35 percent south slopes (WgCS).—This soil ranges from 18 to 38 inches in depth to basalt or caliche. Typically, the surface layer is brown and is only 6 to 10 inches thick. Small fragments of basalt, 1/8 to 1/2 inch in size, are common in the soil material. Where the soil is underlain by caliche, pieces of caliche occur in various sizes and quantities throughout the profile and cause the soil to be calcareous.

This soil occurs in bands on short slopes. In places it is upslope from Starbuck very stony silt loam, 7 to 40 percent south slopes. The areas are only 5 to 35 acres in size. About 5 percent of this mapping unit is of other Walla Walla soils that have a coarse solum and small outcrops of caliche or basalt.

This soil is low in moisture-supplying capacity. Surface runoff is rapid, and the hazard of both water and wind erosion is severe. Tilth is fair, but workability is poor because of the steep slopes and outcrops of rock.

Most of the acreage is used for growing wheat and barley. About 25 percent is used for range. Yields of grain are low, and the response of wheat to nitrogen fertilizer is low. *Capability unit IVe–4; Moderate South Exposure range site; hay and pasture group 3.*

Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes (WhA).—This soil is on broad, gently sloping ridgetops that have a dominant slope of 4 or 5 percent. It is in a transitional area between the Walla Walla soils that are west of Klondike and Grass Valley Canyon and the Ritzville soils on "Starvation Point" in the eastern part of the county. This soil and the following nine soils are in soil association 3.

The surface layer, which extends to a depth of 6 to 12 inches, is grayish-brown, smooth, floury silt loam that has weak platy or granular structure. This layer becomes lighter colored and thinner toward the east.

The subsoil, which averages 28 inches in depth, is brown, smooth, floury silt loam that has weak prismatic structure.

The substratum, which extends to a depth of more than 60 inches, is pale-brown silt loam that is nearly massive. Free lime typically occurs at a depth of about 40 inches. In cultivated areas, a crust forms on the surface, and under the crust is 1 to 3 inches of soil that contains numerous vesicles, or voids. This crusted surface drastically reduces the infiltration of rainfall. When dry, it resembles a cracked pavement.

Surface runoff is slow, and the hazard of water erosion is slight. The moisture-supplying capacity is very high; fertility is high; and workability is good throughout a fairly wide range of moisture content. Yields, however, are slightly lower than on Walla Walla silt loam, very deep, 3 to 7 percent slopes.

This soil is used mainly for growing wheat. The response of wheat to nitrogen fertilizer is medium to high, depending on the amount of precipitation. *Capability unit IIc–1; Rolling Hills range site; hay and pasture group 1.*

Walla Walla silt loam, low rainfall, very deep, 7 to 20 percent north slopes (WhBN).—Most of this soil occurs on north-facing slopes, where the broad ridgetops break to canyons or draws. Normally, the surface is smooth and is broken only by scattered drainage swales, which in most places can be crossed with machinery. The surface layer generally is slightly darker colored and from 2 to 4 inches thicker than that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. Free lime is typically at a depth of more than 55 inches. About 10 percent of this mapping unit is other Walla Walla soils that have low rainfall.

Surface runoff is medium, and there is a moderate hazard of water erosion. Workability is good except on the steepest slopes.

Most of this soil is used for wheat; yields are well above average for the county. The response of wheat to nitrogen fertilizer is medium to high, depending on the amount of precipitation. *Capability unit IIIe–1; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, low rainfall, very deep, 20 to 35 percent north slopes (WhCN).—The profile of this soil is similar to that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes, except that the surface layer generally is slightly darker colored and is from 3 to 5 inches thicker. Normally, calcium carbonate is at a depth of more than 60 inches. This soil is of small extent, and the areas are between 5 and 30 acres in size. It occurs in narrow bands downslope from the less sloping Walla Walla soils that have low rainfall, and in many places upslope from the very steep Nansene soil. Generally, where the slopes have a gradient of less than 30 percent and range from 50 to 200 feet in length, the areas are cultivated; where the slopes are longer and steeper, the areas are used for range. About 5 percent of this mapping unit consists of other Walla Walla soils that have low rainfall.

Surface runoff is rapid, and the hazard of water erosion is severe. The moisture-supplying capacity is very high. Workability is poor. Frost remains in this soil later in spring than in the less sloping Walla Walla soils.

This soil is used about equally for growing wheat and for range. Wheat and forage yields generally are well above average for the county. The response of wheat to nitrogen fertilizer is high. *Capability unit IIIe–1; Moderate North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, low rainfall, deep, 3 to 7 percent slopes (WkA).—This soil occurs extensively on broad, smooth ridgetops. The depth to basalt or caliche ranges from 38 to 60 inches. In many places, lime is at a depth of 36 to 48 inches. About 10 percent of the mapping unit includes other Walla Walla silt loams that have low rainfall.

This soil is high in moisture-supplying capacity, and most of the acreage is used for growing wheat. Yields are slightly lower than yields on Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIc–1; Rolling Hills range site; hay and pasture group 1.*

Walla Walla silt loam, low rainfall, deep, 7 to 20 percent north slopes (WkBN).—This soil occurs near the edge of broad ridge crests. It ranges from 38 to 60 inches in depth to basalt or caliche. The surface layer is a shade darker colored and 2 to 4 inches thicker than that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. An accumulation of lime is common at a depth of about 50 to 55 inches. About 10 percent of this mapping unit is other Walla Walla soils that have low rainfall.

Surface runoff is medium, and water erosion is a moderate hazard. The moisture-supplying capacity is high; tilth is good; and workability is good, except on slopes of more than 16 percent.

This soil is used almost entirely for wheat. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe–1; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla silt loam, low rainfall, deep, 7 to 20 percent south slopes (WkBS).—This soil occurs near the edge of the broad ridge crests. It ranges from 38 to 60 inches in depth to basalt or caliche. The surface layer is 2 to 4 inches thinner than that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. About 10 percent of this mapping unit is other Walla Walla soils that have low rainfall.

Surface runoff is medium, and water erosion is a moderate hazard. The moisture-supplying capacity is good; tilth is good; and workability is good, except on slopes of more than 16 percent. On the steeper slopes, tillage operations are difficult.

Most of this soil is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIe–3; Rolling Hills range site; hay and pasture group 2.*

Walla Walla silt loam, low rainfall, moderately deep, 3 to 7 percent slopes (WmA).—This soil is fairly extensive. It occurs on smooth, gently sloping ridges that have an average slope range of about 4 percent. The depth to basalt or caliche is only 18 to 38 inches. The surface layer typically is 3 to 4 inches thinner than that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. In a few places free lime has accumulated at a depth of more than 30 inches. Small fragments of basalt, 1/8 to 1/2 inch in diameter, are mixed in the soil material. In a few places where the soil is underlain by caliche, pieces of caliche as much as 6 inches in diameter are on the surface and scattered throughout the profile. About 10 percent of this mapping unit consists of other Walla Walla soils that have low rainfall.

Because of moderate depth, this soil is only fair in moisture-supplying capacity and moderate in fertility. Workability is good, and there are no tillage problems except where there are shallow stony drainageways.

Most of the acreage is used for growing wheat or barley. About 15 percent is used for range, of which about half is in native vegetation and about half is seeded to improved perennial grasses. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIs–1; Rolling Hills range site; hay and pasture group 3.*

Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent north slopes (WmBN).—This soil ranges from 18 to 38 inches in depth to basalt or caliche. Small fragments of basalt, 1/8 to 1/2 inch in diameter, are common in the soil material. In most places there is no accumulation of free lime.

This soil occurs mainly on the breaks from gently sloping ridges to large canyons. Typically, the drainageways are shallow and stony, and in places they cannot be crossed with farm equipment. Small areas of other Walla Walla soils that have low rainfall are included in the areas mapped.

Surface runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is good; fertility is moderate; and workability is good except in fields that are dissected by shallow stony drainageways and slopes of more than 16 percent.

This soil is used principally for growing wheat. About 10 percent of the acreage is in native range, and almost 10 percent has been seeded to improved perennial grasses. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIe-3; Droughty North Exposure range site; hay and pasture group 2.*

Walla Walla silt loam, low rainfall, moderately deep, 7 to 20 percent south slopes (WmBS).—This soil occurs extensively on the outer edges of broad ridge crests. It ranges from 18 to 38 inches in depth to basalt or caliche. The surface layer is a shade lighter colored and 3 to 6 inches thinner than that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. Free lime has accumulated in a few places at a depth of more than 2 feet. Many small fragments of basalt, 1/8 to 1/2 inch in diameter, are mixed in the soil material, especially in areas where the depth to basalt is 30 inches or less. In the few places where the soil is underlain by caliche, pieces of caliche as much as 6 inches in diameter are on the surface and throughout the profile.

Typically, field drainageways are shallow and stony and are difficult to cross with farm equipment. About 10 percent of this mapping unit consists of other Walla Walla soils that have low rainfall and of Starbuck soils.

Surface runoff is medium, and the hazard of water erosion is moderate. The moisture-supplying capacity is fair, and fertility is moderate. Except for the shallow stony drainageways, workability and tilth generally are good. Tillage operations are difficult on slopes of more than 16 percent.

Most of the acreage is used for growing wheat. About 20 percent is in native range, is idle, or has been seeded to improved perennial grasses. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-2; Droughty Rolling Hills range site; hay and pasture group 3.*

Walla Walla silt loam, low rainfall, moderately deep, 20 to 35 percent north slopes (WmCN).—This soil occurs mostly in narrow bands, principally along Hay and Grass Valley Canyons. It is not extensive, and the areas are between 5 and 30 acres in size. The surface layer is a shade darker colored than that of Walla Walla silt loam, low rainfall, very deep, 3 to 7 percent slopes. The depth to basalt ranges from 18 to 38 inches, and numerous fragments of basalt, 1/8 to 1/2 inch in diameter, are mixed in the soil material. Free lime commonly does not occur.

Where the length of the slope is less than 200 feet and the gradient typically is less than 30 percent, this soil generally is cultivated. Where the slopes are longer and steeper, it commonly is used for range. Included are small areas of other Walla Walla soils that have low rainfall and of Nansene rocky silt loam, 35 to 70 percent slopes.

Surface runoff is rapid, and the hazard of water erosion is severe. The moisture-supplying capacity is good, and fertility is moderate. This soil is difficult to work. It retains frost later and is wet longer in spring than less steep Walla Walla soils that have low rainfall. Because of the slope, it is unstable in places and tends to creep when wet.

Most of the acreage is used for range. Only about 20 percent is used for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-1; Moderate North Exposure range site; hay and pasture group 2.*

Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes (WnA).—This soil occurs on convex ridgetops and in slightly concave swales. The dominant slope is about 5 or 6 percent. This soil and the following seven soils are in soil association 1.

Representative profile in wheatfield, 4 percent north-facing slope, in NW1/4SW1/4NE1/4 sec. 26, T. 3 N., R. 17 E.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure breaking to weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; many, fine, interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

A12—7 to 13 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark brown (10YR 2/2) when moist; weak, medium, prismatic structure breaking to weak, coarse, subangular blocky structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant roots; common, fine, tubular pores; few, fine and medium-sized pebbles of both basalt and quartz; neutral (pH 6.6); abrupt, smooth boundary.

B21—13 to 22 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; more fine and medium-sized pebbles of both basalt and quartz than in A12 horizon; neutral (pH 6.8); clear, smooth boundary.

B22—22 to 33 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; more and larger pebbles of both basalt and quartz than in B21 horizon; neutral (pH 7.0); gradual, smooth boundary.

C—33 to 40 inches, pale-brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; many, fine, tubular pores; more and larger pebbles of both basalt and quartz than in B22 horizon; neutral (pH 7.2); abrupt, broken boundary.

Dca—40 inches +, caliche and cemented waterworn gravel of basalt and quartz.

Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes, ranges from 38 to more than 60 inches in depth and averages about 40 to 48 inches. In many places it is free of gravel, and in some places it contains fragments of caliche. Free lime generally occurs deep in the profile, except where the depth to caliche is less than 60 inches. About 10 percent of this mapping unit is other Walla Walla very fine sandy loams, and about 3 percent is small outcrops of caliche. In a few places there are outcrops of basalt.

This soil can be worked throughout a wide range of moisture content, but it is susceptible to severe wind erosion if tilled when dry. In many places, the surface layer and uppermost part of the subsoil have been severely eroded by wind. The hazard of water erosion is slight, however, because runoff is slow and permeability is moderately rapid. The moisture-supplying capacity is good; fertility is high; and tilth is good.

Most of the acreage is used for growing wheat. The response of wheat to nitrogen fertilizer is medium to low. *Capability unit IIIc-1; Rolling Hills range site; hay and pasture group 2.*

Walla Walla very fine sandy loam, deep, 7 to 20 percent north slopes (WnBN).—This soil occurs in long, narrow bands, across the slope, generally between areas of gently sloping Walla Walla soils. In places it is upslope from steeper soils. The surface layer is 2 to 3 inches thicker than that of Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes. About 7 percent of this mapping unit is other Walla Walla soils, and about 3 percent is small outcrops of caliche.

Runoff is slow to medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderate but is less than on the ridgetops. The moisture-supplying capacity is high; fertility is high; and workability is good.

Most of the acreage is used for growing wheat. About 10 percent has been abandoned, and about 10 percent is in native range or reseeded range. The response of wheat to nitrogen fertilizer is medium. *Capability unit IIIe-4; Droughty North Exposure range site; hay and pasture group 1.*

Walla Walla very fine sandy loam, deep, 7 to 20 percent south slopes (WnBS).—This soil is similar to Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes, except that the surface layer is about 4 inches thinner; free lime is at a depth of 38 to 48 inches; and the depth to basalt or caliche averages about 44 inches. About 10 percent of this mapping unit is other Walla Walla very fine sandy loams, and about 5 percent is small outcrops of caliche.

Runoff is slow to medium. The hazard of water erosion is slight, and the hazard of wind erosion is moderate. Fertility is high, and workability is good. The moisture-supplying capacity is only fair because of the droughty effects of southern exposures.

Most of the acreage is used primarily for growing wheat. About 10 percent has been abandoned, and almost 10 percent is in native vegetation or has been reseeded to range plants. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-7; Rolling Hills range site; hay and pasture group 3.*

Walla Walla very fine sandy loam, deep, 20 to 35 percent north slopes (WnCN).—This soil generally occurs in long, narrow strips that follow the contour. The areas are between 10 and 30 acres in size. Typically, the surface layer is 15 to 18 inches thick. As much as 10 percent of this mapping unit is other Walla Walla soils and small outcrops of basalt or caliche.

Runoff is slow to medium, and the hazard of water erosion is slight. Wind erosion is a moderate hazard. The moisture-supplying capacity is high. Tilth is good, but workability is poor because of the steep slope.

About half the acreage is used for range, and about half is used for growing wheat. The response of wheat to nitrogen fertilizer is medium to high. *Capability unit IIIe-4; Moderate North Exposure range site; hay and pasture group 1.*

Walla Walla very fine sandy loam, deep, 20 to 35 percent south slopes (WnCS).—This soil is similar to Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes, except that it averages only 38 to 44 inches in depth to basalt or caliche, and the surface layer is about 6 to 9 inches thick and is brown instead of dark grayish brown. About 5 percent of this mapping unit is other Walla Walla soils, and as much as 5 percent is Starbuck extremely stony silt loam, 40 to 70 percent south slopes. Also included are small outcrops of caliche and basalt.

Runoff is slow to medium, and the hazard of water erosion is slight. Wind erosion is a moderate hazard. The moisture-supplying capacity is fair; fertility is moderate; and workability is poor because of the steep slopes.

Many areas are used for growing wheat and barley; other areas are used for range or are abandoned. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-7; Moderate South Exposure range site; hay and pasture group 3.*

Walla Walla very fine sandy loam, moderately deep, 3 to 7 percent slopes (WoA).—This soil ranges from 20 to 38 inches in depth to basalt or caliche. The surface layer normally is 7 to 10 inches thick, but in many places it has been removed by wind erosion. In many places waterworn gravel and fragments of caliche are common throughout the profile. Free lime occurs where caliche is mixed with the soil material. As much as 10 percent of this mapping unit is other Walla Walla soils. About 5 percent is small outcrops of caliche or, in a few places, outcrops of basalt.

Roots penetrate this soil readily but are restricted in growth because of the moderately deep root zone. Fertility is moderate, and workability is good, but the moisture-supplying capacity is low. Wind erosion is a severe hazard.

Most of the acreage is used for growing wheat. Some areas have been abandoned for cultivated crops and are now used for range. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-5; Rolling Hills range site; hay and pasture group 3.*

Walla Walla very fine sandy loam, moderately deep, 7 to 20 percent south slopes (WoBS).—This soil occurs on slightly convex south-facing slopes. The depth to basalt or caliche ranges from 20 to 38 inches. The surface layer is 3 to 4 inches thinner and slightly lighter colored than that of Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes.

Inclusions of other Walla Walla very fine sandy loams make up about 10 percent of this mapping unit. About 5 percent or less is small outcrops of caliche and basalt.

Surface runoff is slow to medium, and the hazard of water erosion is slight. The hazard of wind erosion, however, is moderate. The moisture-supplying capacity is low because of the droughty influence of southern exposures. Fertility is moderate, and workability is good except where the slope is more than 16 percent.

The soil is used principally for growing wheat. The response of wheat to nitrogen fertilizer is low. *Capabil-*

ity unit IVe-5; Droughty Rolling Hills range site; hay and pasture group 3.

Walla Walla very fine sandy loam, moderately deep, 20 to 35 percent south slopes (WoCS).—This soil is similar to Walla Walla very fine sandy loam, deep, 3 to 7 percent slopes, except that the surface layer is only about 6 to 10 inches thick and is brown instead of dark grayish brown; the depth to basalt or caliche ranges from 20 to 38 inches and averages only about 24 inches; and lime occurs only where pieces of caliche are mixed in the soil material.

This soil is of small extent, and the areas are between 5 and 35 acres in size. About 5 percent of the mapping unit is other Walla Walla soils, and as much as 5 percent is Starbuck very stony silt loam, 40 to 70 percent south slopes. Also included are small outcrops of caliche and basalt.

Runoff is slow to medium, and the hazard of water erosion is slight. Wind erosion is a moderate hazard. Fertility is moderate, but the moisture-supplying capacity is low, primarily because of southern exposures, and workability is poor because of the steep slopes.

Much of the acreage is used for grazing. About 30 percent is used for growing wheat and barley. The response of wheat to nitrogen fertilizer is low. *Capability unit IVe-5; Moderate South Exposure range site; hay and pasture group 3.*

Walvan Series

Only one Walvan soil is mapped in Sherman County. This soil has formed from a mixture of volcanic ash and loess. It is not extensive and occurs only on terraces in the southern part of the county. Most areas are gently sloping. Bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass are the principal native plants.

The surface layer, which extends to a depth of 6 to 16 inches, is grayish-brown, neutral to mildly alkaline, slightly hard very fine sandy loam, loam, or coarse silt loam. The uppermost few inches is weak platy to granular; the rest is weak prismatic or platy breaking to weak subangular blocky.

The subsoil, which extends to an average depth of about 30 inches, is light brownish gray and massive. Otherwise it is similar to the surface layer.

The substratum is pale-brown, massive loam that is moderately to very strongly alkaline. The depth to free lime is extremely variable. In places lime occurs intermittently at depths of 11 to 30 inches. Basalt bedrock generally occurs at a depth of more than 60 inches.

This soil holds about 0.13 inch of available moisture per inch of depth. Natural drainage is good, and permeability is moderately rapid.

The Walvan soil is used chiefly for growing wheat. It is associated with the Condon and Hermiston soils.

Walvan loam, 2 to 10 percent slopes (WvB).—This soil occurs mainly on gently sloping north-facing slopes, near streams and around depressed areas that probably were small lakes or ponds. It is upslope from the Condon soils and downslope from the Hermiston soil. The dominant slope is about 7 percent. The areas are between 3 and 60 acres in size.

Representative profile in cultivated area, 90 feet south of section line, 1,000 feet west of road, NE¼ sec. 27, T. 4 S., R. 16 E.

A1p—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish-brown (10YR 3/2) when moist; weak, coarse, platy structure breaking to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; common, fine pores; neutral to mildly alkaline; abrupt, smooth boundary.

A12—7 to 11 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak, medium, platy structure breaking to weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; roots plentiful; common, fine pores; neutral to mildly alkaline; clear, smooth boundary.

C1—11 to 18 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few roots; common, fine, tubular pores; mildly to moderately alkaline; weakly and intermittently calcareous; clear, wavy boundary.

C2—18 to 32 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few roots; common, fine, tubular pores; common, hard and firm, calcareous nodules from 2 to 20 millimeters in diameter; a little coarse sand and fine gravel; strongly calcareous, with segregated and disseminated lime; moderately to strongly alkaline; gradual, wavy boundary.

C3—32 to 48 inches +, pale-brown (10YR 6/3) loam, brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist; slightly sticky and slightly plastic when wet; few roots; few, fine, tubular pores; common, hard and firm, calcareous nodules from 2 to 20 millimeters in diameter; a little coarse sand and fine gravel; few light-gray pumice fragments, 1 millimeter in diameter; strongly calcareous, with disseminated lime; moderately to very strongly alkaline.

The surface layer and subsoil range from 18 to 54 inches in thickness. The surface layer is loam, coarse silt loam, or very fine sandy loam. In a few places the depth to basalt is as little as 40 inches. Small areas of the associated soils are included in this mapping unit.

Walvan loam, 2 to 10 percent slopes, is moderately susceptible to wind erosion, and because of erosion several small areas have been abandoned for cultivated crops. This soil can be worked throughout a wide range of moisture conditions but should not be tilled when dry. Surface runoff is slow, and the hazard of water erosion is slight. Fertility is high, and the moisture-supplying capacity is good.

Most of the acreage is used for growing wheat and barley. About 15 percent is used for range or is idle. The response of wheat to nitrogen fertilizer is low. *Capability unit IIIc-1; Rolling Hills range site; hay and pasture group 2.*

Wrentham Series

Only one Wrentham soil is mapped in Sherman County. This is a dark-colored, somewhat excessively drained, mostly stony or rocky soil that has formed from loess under native vegetation consisting mainly of Idaho fescue and bluebunch wheatgrass. It occurs on very steep north-facing slopes or canyon breaks along the Deschutes and John Day Rivers and their tributaries, in the southern part of the county.

The surface layer, which is 7 to 18 inches thick, is dark grayish-brown, slightly acid or neutral silt loam that is slightly hard when dry. The structure in the uppermost 1 to 3 inches is weak thin platy and breaks readily to weak very fine granular; the structure in the lower part is weak prismatic and breaks to weak subangular blocky. Grass roots are abundant.

The subsoil is brown, slightly hard to hard, neutral heavy silt loam, clay loam, or silty clay loam. The structure is weak prismatic and breaks to weak subangular blocky. The substratum occurs only where the depth to bedrock is more than 60 inches. It is slightly hard, mildly calcareous, massive, gritty silt loam or loam.

The Wrentham soil is used only for range. In most places, it is opposite the Lickskillet soils, which are on south-facing slopes. It is downslope from the less sloping Condon and Bakeoven soils. On some foot slopes, it is adjacent to the Sagemoor soil.

Wrentham rocky silt loam, 35 to 70 percent slopes (WxD).—This soil occurs on very steep north-facing canyon breaks. The dominant slope is about 55 percent.

The slopes generally are long. Along the John Day and Deschutes Rivers, they range from 400 to 800 feet in length; along the tributaries, from 200 to 400 feet in length. Typically, the areas are rocky, and basalt rimrock and debris are common. Small springs are more common along the Deschutes River.

Representative profile in native range, 62 percent north-facing slope, 900 feet south and 300 feet west of center of NE¼SW¼ sec. 31, T. 3 S., R. 15 E.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure breaking to weak, very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; few, very fine and fine, interstitial pores; slightly acid (pH 6.4); abrupt, smooth boundary.

A12—2 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; few, fine, tubular pores; slightly acid (pH 6.5); abrupt, smooth boundary.

B1—8 to 17 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant roots; few, fine, tubular pores; few, thin, discontinuous clay films on ped surfaces; neutral (pH 6.6); gradual, smooth boundary.

B21—17 to 25 inches, brown (7.5YR 5/4) heavy silt loam, dark brown (7.5YR 3/4) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky structure; hard when dry, firm when moist, slightly sticky and plastic when wet; abundant roots; few, fine, tubular pores; many, thin, discontinuous clay films on ped surfaces; neutral (pH 6.7); clear, smooth boundary.

B22—25 to 32 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; abundant roots; few, fine, tubular pores; many, thin, discontinuous clay films on ped surfaces; neutral (pH 6.8); abrupt, wavy boundary.

D—32 inches +, basalt bedrock.

The depth of this soil to basalt bedrock ranges from 18 inches to more than 60 inches and averages about 30 inches. Small areas of the Lickskillet, Condon, and Bakeoven soils and other associated soils are included in this mapping unit. As much as 15 percent consists of Rock outcrop and rubble land. These rocky areas are indicated on the detailed soil map by symbols.

In many places Wrentham rocky silt loam, 35 to 70 percent slopes, is not stable and tends to slip or creep when wet. Frost and colluvial action are common. Natural drainage is somewhat excessive; permeability is moderately slow; and surface runoff is rapid to very rapid, especially during intense storms or rapid snowmelt. The erosion hazard is moderate if the range is in poor condition. The moisture-supplying capacity is high, and fertility is moderate.

This soil is too steep and too rocky to be cultivated. All of the acreage is used for range. Reseeding for the improvement of the range is not feasible. In many places rimrock of basalt and debris are natural barriers to livestock. The development of springs will increase the utilization of the range. *Capability unit VIIs-1; Steep North Exposure range site.*

Genesis, Classification, and Laboratory Data

This section has four main parts. The first explains the five soil-forming factors; the second discusses the processes of soil formation in Sherman County; the third classifies the soils by higher categories; and the fourth gives laboratory data on selected soil profiles.

Factors of Soil Formation

Soils are natural bodies of loose material at the surface of the earth. The properties of the soil at any given place are determined by the combination of five factors: (1) the physical and mineralogical composition of the parent soil material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) organisms, chiefly vegetation; (4) the relief, or lay of land; and (5) the length of time the forces of development have acted on the material. There are innumerable combinations of these factors. The relative importance of each differs from place to place. In some places, one factor may dominate in the formation of the soil and fix most of its properties, but generally a combination of the five factors determines the characteristics of any soil.

Parent material

The soils of Sherman County have formed from five kinds of parent material: (1) loess, (2) mixtures of volcanic ash and loess, (3) mixtures of loess and residuum from basalt, (4) windblown sands, and (5) water deposits consisting of both stream alluvium and silty lake deposits. The two geologic bedrock formations that have influenced the soils are the Columbia River Basalt of the Miocene Epoch and the Shutler formation of the Pliocene Epoch. The geology of the county is discussed in the section "General Nature of the County."

Loess is by far the most important parent material. It has affected to some extent every major soil in the county. It is a sediment, commonly nonstratified and unconsolidated, that has been deposited by the wind. It is composed dominantly of silt-sized particles of feldspar, quartz, calcite, and mica, ordinarily with accessory clay and sand. Typically, loess is very smooth and floury.

The loess probably originated from glacial outwash left in the present channel of the Columbia River during the Ice Age, or Pleistocene Epoch. The loess probably accumulated chiefly in warm periods, during the melting of the glaciers when the sedimentation of outwash was at a maximum and the ground surface was neither frozen nor blanketed with snow. Winds from the northeast, blowing across the bare outwash evidently started sand grains moving in a jumping motion. The jumping grains bombarded the surface and kicked silt particles into the air stream. The silt and finer textured sand particles were carried toward the southwest and gradually settled over a wide area.

In this area, there is a relationship between the texture and thickness of the loess. Closer to the source, the deposits are coarser textured and thicker. In a southerly direction, the deposits become finer textured and thinner. The descriptions of profiles 3, 6, and 11 in the subsection "Laboratory Data on Selected Soil Profiles" substantiate this fact.

In a few places loess is weakly stratified within about 2 feet of the surface. There are at least three explanations for this stratification: (1) the very recent drifting of soil as a result of cultivation, (2) initial deposition in small temporary ponds, and (3) variations in the force of the wind during the initial deposition.

Along road cuts in the county, the loess stands in vertical banks as much as 15 feet thick. This phenomenon, peculiar to loess and common wherever loess occurs, is a result of the individual plate-shaped particles being laid down flat, much like the pages of a book. On rounded surfaces, however, because of the uniform size of the particles, loess is susceptible to water erosion if not protected by vegetation.

Loess contains a wide variety of minerals. From it, under conditions for weathering such as those in Sherman County, highly fertile soils have formed. The soils in the county that have formed from loess are those of the Condon, Kuhl, Nansene, Ritzville, Starbuck, Walla Walla, and Wrentham series.

At one or more times during the deposition of the loess, windborne volcanic ash also was deposited in the county. Most likely it came from the now extinct volcanoes of the Cascade Mountains. All of the soils in the county probably contain some volcanic ash, which consists of sharp-edged, sand-sized to silt-sized particles of silica, feldspar, glass, and other materials. Because volcanic ash is extremely susceptible to movement by both wind and water, nearly all of the original deposits have been removed from the uplands and redeposited along streams, or they have been blown or washed away. Only remnants, mostly intermixed with loess, remain. The Walvan soil has formed in this material. In many places, the Hermiston soil, which has formed in alluvium, contains a layer that is high in volcanic ash. Some soils developed mainly in volcanic ash are not fertile. Soils formed in a mixture of volcanic ash and loess vary in fertility according to the amount and composition of volcanic ash in the parent material.

The Lickskillet and Bakeoven soils have developed in a mixture of loess and basalt residuum. These soils are shallow or very shallow and are extremely stony or very stony. There probably has been little soil material weathered from the basalt. The Quincy soil has developed in windblown sands along the Columbia River. The sands may have originally been deposited by water and may be remnants of the glacial outwash that once filled the gorge, but they have been reworked and shifted by the wind. The Hermiston, Pedigo, and Sagemoor soils have developed in materials deposited by water. The Hermiston soil, which occurs on most of the canyon bottoms, has formed in silty sediments from the loessal uplands mixed with volcanic ash and basalt material. In many places, there are stone lines in the profile. The Pedigo soil, a wet soil of minor extent, has formed in similar materials. The Sagemoor soil has formed in the remnants of silty lake-laid sediments, most of which were washed away when the lake apparently dropped rapidly. Almost all of this soil is on the slip-off slopes of the Deschutes and John Day Rivers, at elevations of 600 to 1,000 feet.

Climate

The climate of Sherman County is of the semiarid, continental type characteristic of the Intermountain Region of Northwestern United States (*17*). The average temperatures and distribution of rainfall, by months, are shown in table 13, p. 97.

The climate is fairly uniform throughout the county; the average annual precipitation ranges from about 12 inches in the western part to about 10 inches in the eastern part. Winds, while generally strong, are significantly stronger north of Wasco.

Because of differences in exposure, the effects of climate on soil development are different in different parts of the county. For example, on north-facing slopes the amount of effective moisture is much greater than in gently sloping areas; in turn, in gently sloping areas the effective moisture is much greater than on south-facing slopes.

Approximately 60 percent of the precipitation occurs in the coldest months, from November through March, when chemical and biological activity are at a minimum. Under natural conditions, most of the precipitation is absorbed by the soils. The rate of soil development, which depends largely on chemical and biological activity, is slower than it would be if more of the precipitation came during the warmer months. Moreover, during July and August the soils are dry, and soil development is virtually at a standstill. The leaching of carbonates is deep because little moisture is lost either by runoff or by evaporation during the winter season. The formation and translocation of clay are retarded, however. These processes are more rapid in warm periods; therefore, in this county, they occur mainly in spring and early in fall.

Organisms

Sherman County is the only county in Oregon that has no forests. When the first white man came, the vegetation consisted mainly of bunchgrasses. The only trees were a few cottonwoods and willows scattered along the streams and a few junipers in the outcrops of rock.

There are four principal plant communities in the county. They are identified by the dominant forage species. In order of decreasing moisture requirements, these four communities are (1) Idaho fescue-bluebunch wheatgrass; (2) bluebunch wheatgrass-Idaho fescue; (3) bluebunch wheatgrass-Sandberg bluegrass; and (4) Sandberg bluegrass-bluebunch wheatgrass.

Soils that have formed under the Idaho fescue-bluebunch wheatgrass vegetation have the highest organic-matter content; those that have formed under the Sandberg bluegrass-bluebunch wheatgrass vegetation, the least.

Minor plant communities in the county are (1) saltgrass-giant wildrye, (2) bluebunch wheatgrass-giant wildrye, and (3) needlegrass-bluebunch wheatgrass.

Micro-organisms and living organisms other than grasses have played a minor role in soil development in the county. In places burrowing animals have slowed down horizonation by mixing genetic layers that have already formed. Man, too, has influenced soil formation. He has reduced the content of organic matter and has altered the structure of the surface soil, through tillage, and thereby caused accelerated erosion.

Relief

Sherman County is a small part of a large basalt plateau. The faulting, fracturing, and incising of this plateau has resulted in the formation of many canyons. Along the major fault lines, there are tremendous gorges, and the most striking relief is along these gorges, or canyons. Away from the major drainageways, the differences in elevation seldom are more than 100 feet.

Directly or indirectly, relief has caused significant differences in the soils in the county. Parent materials occur where they do mainly because of relief. Soils on very steep slopes commonly contain basalt colluvium. Alluvial soils on narrow, nearly level bottoms consist of materials washed and blown from the uplands. The elevation of soils formed in silty lake deposits is either at or below the level of the former lakes. The depth and texture of loessal deposits are determined not only by the distance from the source but also by differences in the local landform. Ordinarily, loess is deeper on north-facing slopes than on south-facing slopes. Presumably, this is because (1) north-facing slopes, at their angle to the dust-laden winds, have intercepted more of the loess and have provided the greatest surface for deposition; (2) the vegetation at the time of deposition was more dense on north-facing slopes than on south-facing slopes; (3) erosion was greater on south-facing slopes; and (4) during periods when southwesterly winds prevailed, loess from south-facing slopes was redeposited on north-facing slopes.

The aspect, or exposure to the sun, has been a prime factor in the formation of soils in the county because the supply of moisture is more effective on north-facing slopes than on south-facing slopes. Laboratory analysis shows that the Lickskillet soils that are on south-facing slopes have a lower carbon-nitrogen ratio and are lower in organic-matter content than the Walla Walla soils that are on gentle north-facing slopes (see table 8). Table 7 shows the kind of parent materials from which the soils in the county were derived and their degree of development and the dominant aspect.

Natural drainage is influenced by relief and parent material. In well-drained soils, water is removed readily but not rapidly; in poorly drained soils, the root zone is waterlogged for long periods, and the roots of ordinary crops cannot get enough oxygen; in excessively drained soils, water is removed so completely that crops may wither and die from lack of water. The effect of soil drainage commonly is reflected indirectly in the kind and amount of vegetation. Most soils in Sherman County are well drained. The Pedigo soil, which has formed chiefly under giant wildrye, is poorly drained, and the Quincy soil, which has formed chiefly under bluebunch wheatgrass, is somewhat excessively drained. Both, however, are of minor extent. In places the Hermiston soil has an intermittent high water table. This has resulted in some alkali spots.

TABLE 7.—*Parent materials, aspect, and degree of development*

Parent materials and dominant effective aspect	Degree of development			
	No textural B horizon; light-colored A horizon	No textural B horizon; dark-colored A horizon	Textural B horizon; light-colored A horizon	Textural B horizon; dark-colored A horizon
Loess:				
No pronounced aspect	Ritzville	Walla Walla, Condon.		
Shallow, stony or rocky	Starbuck	Kuhl		
Pronounced north aspect		Nansene		Wrentham.
Volcanic ash and loess		Walvan		
Mixture of loess and residuum of basalt:				
No pronounced aspect			Bakeoven	
Pronounced south aspect			Lickskillet	
Windblown sand	Quincy			
Water deposits:				
Stream alluvium		Hermiston, Pedigo		
Silty lake deposits	Sagemoor			

Time

Geologically, the soils of Sherman County are young. Probably most of the parent material was deposited during the last 11,000 years. The basic lava rock, of course, is considerably older, but, except for modifying the texture, its influence on parent materials has not been great.

None of the soils in the county have strongly developed horizons. If the development of horizons has proceeded uniformly in all soils in the county, then the Lickskillet and Wrentham soils are the oldest. In addition to a dark-colored A horizon, they have a weak to moderate B horizon that contains more clay than the A horizon. However, the formation of horizons in these soils may have proceeded more rapidly because of the nature of the parent material, or the B horizon may consist of buried layers inherited from a former cycle of soil development. The Hermiston, Pedigo, Quincy, Sagemoor, and Starbuck soils have the least clearly expressed horizons; the strongest evidence of horizonation is a faint darkening of the surface layer by organic matter.

Morphology of Soils

A soil is not easily studied in its natural position, because only the surface is exposed. To see and study a soil, it is necessary to expose a vertical section, or profile. Then it is possible to examine a soil in its natural form. A profile generally consists of several layers, or horizons.

In Sherman County, the differentiation of horizons is the result of one or more of the following: (1) accumulation of organic matter in A horizons, (2) accumulation of silicate clay in B horizons, (3) retention of Ca, K, and Mg to give high base saturation, (4) accumulation or retention of calcium carbonate in lower horizons, and (5) accumulation of exchangeable sodium. In all of the soils in the county, two or more of these have operated in the development of horizons. The Walla Walla soils, for example, reflect the first, third, and fourth; whereas, the Condon soils have been influenced by the first, second, and third.

Accumulation of organic matter in A horizons.—Organic matter has accumulated in the surface layer of all of the soils in the county to form an A1 horizon. The quantities are lowest in the Sagemoor, Quincy, and Bakeoven soils and highest in the Nansene and Wrentham soils. Laboratory data given in table 8 indicate that two of the soils that are used for range, the Lickskillet soil (profile number 4) and the Condon soil (profile number 3), have organic-matter levels of 1.3 and 4.2 percent, respectively. On the other hand, the Walla Walla soil (profile number 8), which has been cultivated for about 80 years, has an organic-matter level of 1.6 percent. The removal of native vegetation from the Walla Walla soil and the subsequent reduction in organic matter under a summer-fallow system of farming have markedly changed the structure and water-absorbing ability of its A1 horizon. Surface crusting, vesicular porosity, and massive or platy structure are common in this disturbed horizon.

Accumulation of silicate clay in B horizons.—Laboratory data on the content of clay show that the Lickskillet soils have textural B horizons. The Bakeoven and Wrentham soils also have textural B horizons, but no data are available on these soils. Textural B horizons may have resulted from (1) the translocation of silicate clay minerals, (2) a greater formation of clay from primary minerals within the B horizon than within other horizons, or (3) buried layers of older soils.

Retention of Ca, K, and Mg to give high base saturation.—All of the soils in the county have high base saturation. Although no data are available, the Sagemoor soil probably has the highest, and the Wrentham and Nansene soils the lowest.

Accumulation or retention of calcium carbonate in lower horizons.—There is visible evidence of leaching of carbonates and salts in most soils in the county. The Sagemoor soil, which has been leached the least, contains calcium carbonate near the surface; whereas, the Wrentham and Nansene soils, which have been leached the most, generally contain no carbonates. Laboratory data for the Walla Walla soils (profile numbers 9, 11, and 12) show calcium carbonate in the lower horizons in addition to a high base saturation throughout the profiles. In the Ritzville soil, the calcium carbonate occurs closer to the surface than in Walla Walla soils. The occurrence of a caliche hardpan, especially in the northern part of the county, probably is geologic rather than pedogenic. The pan probably is a remnant of an earlier soil formation on the Shutler formation and not a soil formation in the loess. A thin pan occurs in the Walla Walla soils in a few places in the eastern part of the county. This appears to be the result of soil-forming processes in the loess.

Accumulation of exchangeable sodium.—The Pedigo soil and the wet spots in Hermiston soil have high sodium saturation. This is a very minor condition in the county and probably has been caused by the sodium in the ground water replacing other exchangeable cations.

Classification

Soil classification is a systematic arrangement of soils based on natural relationships and characteristics.

The system of soil classification used in the United States places the soils in six categories (*13*). Beginning with the most inclusive, these categories are the order, suborder, great soil group, family, series, and type.

There are three soil orders, and thousands of soil types. The suborder and family categories have not been fully developed and, thus, have been little used. Attention has been directed largely toward great soil groups, series, and types.

The three orders are the zonal, the intrazonal, and the azonal. The zonal order consists of soils that have evident, genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. The intrazonal order consists of soils that have evident, genetically related horizons that reflect the dominant influence of one or more of the local factors—parent material or topography—over the effects of climate and living organisms. The azonal order consists of soils that lack distinct, genetically related horizons because of one or more of the following: youth of parent material, resistance of parent material to change, or steep topography. Only the zonal and azonal orders are represented in Sherman County.

The third category from the top of the classification system—the great soil group—consists of several soil series that have the same general sort of profile. Soils of different series within the same great soil group have, however, significantly different parent material and relief, or they differ in degree of development.

Soil series and soil types are defined and discussed in the section "How Soils are Named, Mapped, and Classified." In the following list, the soil series in Sherman County are arranged in soil orders and great soil groups. Following the list, there is a discussion of great soil groups represented in the county.

- Zonal soils:
  - Brown soils—
    - Bakeoven
    - Lickskillet
    - Ritzville
  - Chestnut soils—
    - Condon
    - Kuhl
    - Walla Walla
  - Chernozems—
    - Wrentham
    - Nansene
  - Sierozems—
    - Sagemoor
- Azonal soils:
  - Alluvial soils—
    - Pedigo
    - Hermiston
  - Regosols—
    - Quincy
    - Starbuck
    - Walvan

Brown soils

Brown soils are zonal soils that have a brown surface horizon that grades to a lighter colored layer and finally to a layer of lime accumulation. These soils developed under short grasses, bunchgrasses, and shrubs in a temperate to cool, semiarid climate (*14*).

This great soil group is represented in Sherman County by the Lickskillet, Ritzville, and Bakeoven soils. These soils do not correspond precisely to the definition of the group. Lickskillet soils lack a layer of carbonate accumulation. The Ritzville soils are in a dryer climatic area than the dominant Chestnut soils. The Lickskillet and Bakeoven soils are in a climatic area where the dominant soils are classified as Chestnut soils, but both have a lower moisture supply than the surrounding Chestnut soils, the Lickskillet because of pronounced southern exposure and the Bakeoven because of their very shallow profile. The Ritzville soils lack a textural B horizon but do have a weak structural B horizon. However, they barely come within the limits of the zonal order and could be considered as intergrades to the Regosol great soil group. The Bakeoven soils are shallow and contain a high proportion of basalt. They have a thin, weak, granular B horizon that shows some evidence of clay accumulation.

Chestnut soils

Chestnut soils are zonal soils that have a dark-brown surface horizon that grades to a lighter colored horizon and finally to a layer of lime accumulation. These soils have developed under mixed tall and short grasses in a temperate to cool, subhumid to semiarid climate. They grade into the Chernozems that are at the more arid extreme of the climatic range for Chernozems (*13*).

This great soil group is represented in Sherman County by the Condon, Kuhl, and Walla Walla soils. The Condon soils are most nearly typical of this group, but only the deeper profiles have a layer of lime accumulation. The Kuhl and Walla Walla soils have a weak structural B horizon but lack a textural B horizon. Weak horizonation would permit these last two soils to be classed either as Chestnut soils or as Regosols.

In Sherman County, the property that best expresses horizon differences is the amount of clay in the B horizon. In the field, this can be judged by observing the clay films on ped surfaces and in pores and by feeling the soil when it is wet for the degree of stickiness.

The Walla Walla soils have little clay in the B horizon and show no evidence of movement of clay from the A to the B horizon. The content of clay is greater and the movement of clay more obvious in the Condon soils. The principal reasons for this difference are that the size of the original particles becomes progressively finer from north to south, and that the soils become progressively more shallow. There is also a third possibility: The most recent additions of loess may have extended only over the northern part of the county so that the soils in the southern part are older. Therefore, the effect of weathering has been considerably less on the Walla Walla soils, which are in the northern part of the county, than on the Condon soils, which are in the southern part, in spite of the fact that there is less precipitation in the southern part. Consequently, the Condon soils have stronger horizonation.

Chernozems

Chernozems are zonal soils that have a deep, dark-colored to nearly black surface layer that is rich in organic matter. This horizon grades to a lighter colored horizon and finally to a layer of lime accumulation. The soils developed under tall and mixed grasses in a temperate to cool, subhumid climate (*14*).

This great soil group is represented in Sherman County by the Wrentham and Nansene soils. Neither, however, is entirely typical of this group. In both, the layer of lime accumulation either is lacking or is at a depth of more than 5 feet. The Wrentham and Nansene soils have been leached to a greater depth than the Chernozems of the Great Plains because most of the precipitation in the county is in winter when evaporation is at a minimum. The Wrentham soils have a textural B horizon. The Nansene soils lack a textural B horizon. They have weak horizonation and probably are an intergrade to the Regosol great soil group.

The Chernozems in Sherman County have formed only on pronounced northern exposures in a climatic area where the dominant soils are classified as Chestnut soils.

Sierozems

Sierozems are zonal soils that have a brownish-gray surface horizon that grades through lighter colored materials to a layer of lime accumulation or, in places, to a hardpan. The soils in this group have formed under mixed short grasses, bunchgrasses, and shrubs in a temperate to cool, arid climate.

This great soil group is represented in Sherman County by the Sagemoor soils.

The presence of these soils in areas where Brown and Chestnut soils are common may be due to (1) local reduction in precipitation because of the relatively low elevation of these soils; (2) excessive evaporation of moisture because of higher temperatures at the lower elevation; (3) excessive runoff and loss of ground water because of the position of these soils on narrow benches or canyon walls; or (4) the high content of calcium carbonate in the parent materials of these soils.

Alluvial soils

Alluvial soils are azonal soils that consist of transported and recently deposited material. They are characterized by a weak modification, or no modification, of the original material by soil-forming processes (*13*).

This great soil group is represented in Sherman County by the Pedigo and Hermiston soils. The Pedigo soils are not nearly so typical of the group as the Hermiston soils. They have a predominantly weak subangular blocky A horizon of dark-brown to black silt loam to silty clay loam, and a C horizon of dark-gray silty clay loam that has structure much like that of the A horizon.

Regosols

Regosols are azonal soils that consist of unconsolidated rock or soft mineral deposits, in which few or no clearly expressed soil characteristics have developed. These soils are on largely recent sand dunes or loess and glacial drift on steep slopes (*4*).

The Quincy, Walvan, and Starbuck soils represent the Regosol great soil group in Sherman County. All of these soils are fairly typical of this group except the Starbuck. The Starbuck soils have a weak prismatic AC horizon. They could be considered Regosols intergrading toward Brown soils. The Quincy soils have a horizon sequence of A, AC, or C; but because of fire and subsequent reworking by wind, the A1 horizon is difficult to observe. Commonly it is lighter colored than the AC horizon or the uppermost part of the C horizon. In many places the C horizon shows a weak accumulation of calcium carbonate.

Laboratory Data on Selected Soil Profiles

This section includes laboratory data and profile descriptions for 12 selected soils. Several of the samples tested were taken from Wasco County, Oregon, but the soils are essentially the same as those of the same series mapped in Sherman County. Table 8 summarizes the chemical properties of these soils.

In preparation for laboratory analysis, air-dried samples were crushed with a rolling pin to pass through 2-millimeter, round-hole screen, and then were stored in closed containers.

To determine pH, laboratory distilled water was added to 20 grams of soil to make a consistency of the saturation percentage, and allowed to stand for 1 hour before reading the pH in a Beckman Model H–2 meter. The same sample was subsequently diluted with distilled water to a 1:10 soil-water ratio, and the pH determined after 1 hour. The electrodes were placed deep in the suspension immediately after the final stirring.

Calcium carbonate equivalent was determined by using a modification of Passon's method, described in Soil and Plant Analysis by C. S. Piper, and a modification of the D. E. Williams' method described in "A Rapid Manometric Method for the Determination of Carbonate in Soils" (*10*, *17*).

Organic carbon was determined by the $K_2Cr_2O_7$–H_2SO_4 heat of dilution method described in "Methods of Soil Analyses for Soil-Fertility Investigations," U.S. Department of Agriculture Circular No. 757 (*9*). Soil was removed by filtration prior to titration with $FeSO_4$ and ortho-phenanthroline as indicator. Organic carbon was

TABLE 8.—*Chemical properties of 12 selected soil*

Profile number, soil type, and sample number	Horizon	Depth from surface	pH		$CaCO_3$ equivalent	Organic matter [1]		
			Saturated paste	1:10		Organic carbon	Nitrogen	C/N ratio
Profile No. 1, Condon silt loam (S57–Ore–33–10):		*In.*			*Pct.*	*Pct.*	*Pct.*	
57246	Ap	0–7	6.4	6.1	0	0.68	0.068	10.0
57247	B1	7–10	6.7	6.4	0	.56	.068	8.2
57248	B2	10–18	7.0	6.8	0	.40	.058	6.9
57249	B3	18–24	6.6	7.3	0	.50	------	----
Profile No. 2, Condon silt loam (S57–Ore–33–11):								
57251	Ap	0–7	6.5	6.3	0	.80	.076	10.5
57252	B1	7–10	6.3	6.1	0	.69	.073	9.5
57253	B2	10–18	6.8	6.5	0	.56	.066	8.5
57254	B3	18–29	7.3	7.4	0	.48	.065	7.4
Profile No. 3, Condon silt loam (S57–Ore–28–1):								
57295	A11	0–4½	6.5	6.6	0	2.44	.186	13.1
57296	A12	4½–11	6.9	6.8	0	1.03	.101	10.2
57297	B2	11–18	7.0	7.0	0	.68	.078	8.7
57298	B3	18–26	7.2	7.3	0	.58	.070	8.3
Profile No. 4, Lickskillet very stony loam (S57–Ore–28–8):								
57337	A1	0–5	7.3	7.4	0	.74	.076	9.7
57338	B1	5–9	6.9	6.8	0	.54	.068	7.9
57339	B2	9–20	6.9	6.8	0	.49	.065	7.5
Profile No. 5, Lickskillet extremely stony loam (S57–Ore–28–9):								
57341	A1	0–4	6.9	6.8	0	.50	.053	9.4
57342	B1	4–9	7.2	6.9	0	.50	.057	8.8
57343	B21	9–14	6.8	7.1	0	.51	.061	8.4
57344	B22	14–22	6.5	6.5	0	.44	.050	8.8

calculated on the basis of 77 percent oxidation of organic matter.

Total nitrogen was determined by the Kjeldahl method (*2*). Electrical conductivity of the saturation extract was analyzed by method 3a given in "Diagnosis and Improvement of Saline and Alkali Soils," U.S. Department of Agriculture Handbook No. 60 (*15*). Method 19 of U.S. Department of Agriculture Handbook No. 60 was followed to determine cation exchange capacity, except that 10 grams of soil were used (*15*). Aliquots were evaporated, and the NH_4Ac and organic matter removed with HNO_3 and HCL. Silica was dehydrated with 6N HCL. Residue was dissolved in 0.4N HCL, and Na determined by a Beckman Model DU flame spectrophotometer.

Extractable Ca, Mg, Na, K, and H were determined according to methods described in U.S. Department of Agriculture Circular No. 757 (*9*). Fifty grams of soil were extracted with 500 millimeters of one normal neutral NH_4Ac (pH 7). Calcium was precipitated as the oxalate and titrated with permanganate; Mg as ammonium magnesium phosphate, ignited and weighed as $Mg_2P_2O_7$. Separate aliquots of the NH_4Ac extracts for sodium and potassium were treated the same as NH_4Ac extracts for determinations of cation exchange capacity. Sodium and potassium were analyzed in 0.4N HCl by a Beckman flame spectrophotometer. Extractable Na and K were obtained by subtracting soluble Na and K, if present in the saturation extract, from the NH_4Ac extractable values. (Extractable Na divided by the cation exchange capacity, as determined by NaAc procedure, multiplied by 100 represents the exchangeable Na percent.)

Sodium and potassium in the saturation extract were analyzed by a Beckman flame spectrophotometer. Calcium and magnesium were determined according to Method 7 in U.S. Department of Agriculture Handbook No. 60 (*15*). Carbonate and bicarbonate, and chloride in saturation extract were analyzed by methods 12 and 13 respectively.

Results of the particle-size distribution studies are shown in table 9. The particle-size distribution was determined by the pipette method (*6*, *7*).

Coarse fragments more than 1 inch in diameter were excluded from the samples brought to the laboratory. The percentage greater than 2 millimeters includes fragments up to 1 inch in diameter. Estimates of coarse fragments are given in the profile descriptions.

Table 10 shows the physical properties of the 12 selected soils. Bulk density samples were taken in a steel tube that has a diameter of 4.7 centimeters, a length of 3.5 centimeters, and a volume of 60.72 cubic centimeters. The tube was driven into the face of the profile. In some places the face of the profile was moistened with a wash bottle so that the soil extending from the end of the tube would cohere when the tube was removed. Not all horizons or profiles could be sampled. The values were obtained from single determinations.

Moisture retention at 1/10, 1/3, and 15 atmospheres was determined by methods 29, 30, and 31, respectively, described in U.S. Department of Agriculture Handbook No. 60 (*15*).

The mineralogical composition of the 20–50 micron fraction of selected horizons of the Walla Walla and Condon soils are shown in table 11.

Following table 11 are the profile descriptions of the 12 selected soils.

profiles from Sherman and Wasco Counties, Oreg.

Electrical conductivity (Ecx10^3)	Cation exchange capacity (NaAc)	Extractable cations (meq./100 gm.)					Base saturation	Saturation extract soluble (meq./l.)							Moisture at saturation
		Ca	Mg	H	Na	K		Na	K	Ca	Mg	Cl	CO_3	HCO_3	
mmhos. per cm. at 25° C.							*Pct.*								*Pct.*
0. 2	21. 7	8. 7	4. 4	3. 6	0. 1	1. 0	80	0. 6	0. 3	1. 2	0. 9	0. 5	0	2. 1	31. 0
. 3	21. 7	10. 9	5. 8	3. 0	. 1	1. 0	86	. 7	. 3	1. 5	1. 0	. 3	0	2. 0	38. 1
. 3	26. 5	12. 2	6. 9	2. 0	. 2	. 9	91	. 5	. 3	1. 4	1. 2	. 2	0	2. 3	41. 4
. 4	26. 5	12. 4	6. 9	1. 5	. 2	. 9	93	1. 0	. 2	1. 7	1. 3	. 4	0	2. 6	38. 5
. 3	22. 8	9. 5	4. 9	3. 8	. 1	1. 2	81	. 5	. 5	1. 3	1. 0	. 2	0	1. 9	30. 2
. 3	23. 4	9. 6	5. 4	3. 7	. 1	1. 0	81	. 6	. 3	1. 5	1. 4	. 3	0	1. 7	34. 8
. 3	28. 7	12. 5	7. 9	2. 9	. 1	. 9	88	. 8	. 2	1. 7	1. 5	. 2	0	2. 6	41. 6
. 4	28. 5	13. 1	8. 3	1. 6	. 3	. 7	93	1. 2	. 2	1. 9	1. 8	. 3	0	2. 5	39. 2
. 5	22. 0	12. 1	4. 8	4. 8	. 2	2. 0	80	. 2	1. 2	2. 4	1. 6	. 2	0	3. 7	52. 2
. 4	22. 6	12. 5	6. 2	3. 1	. 4	1. 7	86	. 5	. 7	2. 1	1. 4	. 2	0	3. 6	40. 6
. 3	22. 6	13. 1	6. 1	2. 6	. 5	1. 2	89	. 4	. 4	1. 2	1. 1	. 2	0	2. 1	37. 5
. 3	21. 8	12. 6	7. 4	1. 5	. 5	. 8	93	. 5	. 2	1. 5	1. 4	. 2	0	2. 6	43. 9
. 4	21. 6	11. 8	5. 5	2. 8	. 3	1. 1	87	. 4	. 4	2. 2	1. 5	. 1	0	4. 0	31. 6
. 3	23. 6	14. 0	6. 5	3. 0	. 3	1. 1	88	. 3	. 3	1. 7	1. 1	. 2	0	2. 9	36. 9
. 2	27. 5	17. 0	6. 6	3. 3	. 3	1. 1	88	. 6	. 4	1. 3	. 9	. 2	0	2. 5	43. 3
. 3	19. 7	12. 2	4. 8	2. 2	. 3	1. 3	89	. 3	. 4	1. 5	. 9	. 2	0	2. 8	29. 4
. 3	24. 2	15. 8	4. 8	2. 3	. 3	1. 2	91	. 4	. 4	1. 7	1. 1	. 1	0	3. 1	30. 6
. 3	35. 4	25. 7	4. 7	8. 5	. 3	1. 7	79	. 4	. 3	1. 6	1. 1	. 3	0	3. 7	39. 2
. 3	38. 0	28. 9	4. 5	9. 9	. 4	1. 3	78	. 6	. 3	1. 9	1. 3	. 3	0	3. 6	41. 6

TABLE 8.—*Chemical properties of 12 selected soil*

Profile number, soil type, and sample number	Horizon	Depth from surface	pH		CaCO3 equivalent	Organic matter [1]		
			Saturated paste	1:10		Organic carbon	Nitrogen	C/N ratio
Profile No. 6, Condon silt loam (S57-Ore-33-12):		*In.*			*Pct.*	*Pct.*	*Pct.*	
57256	A1p	0-4	6. 4	6. 5	0	1. 18	0. 105	11. 2
57257	A12	4-8	6. 4	6. 5	0	1. 06	. 100	10. 6
57258	B21	8-14	6. 6	6. 4	0	. 85	. 084	10. 1
57259	B22	14-19	6. 7	6. 7	0	. 57	. 065	8. 8
57260	B3	19-21	7. 0	6. 9	0	. 38	. 046	8. 3
57261	C	21-23	7. 0	7. 0	0	. 38	----------	------
Profile No. 7, Walla Walla silt loam (S57-Ore-28-2):								
57299	A1p	0-8	6. 2	6. 4	0	. 82	. 069	11. 9
57300	A1pm	8-9½	6. 3	6. 4	0	. 63	. 062	10. 2
57301	A12	9½-16	6. 7	6. 8	0	. 55	. 061	9. 0
57302	B21	16-24	7. 0	6. 9	0	. 47	. 055	8. 5
57303	B22	24-37	7. 6	7. 6	0	. 41	. 054	7. 6
Profile No. 8, Walla Walla silt loam (S57-Ore-28-3):								
57305	A1p	0-8	6. 0	6. 2	0	. 95	. 090	10. 6
57306	A1pm	8-9½	6. 3	6. 3	0	. 78	. 077	10. 1
57307	B21	9½-18	6. 9	6. 7	0	. 61	. 071	8. 6
57308	B22	18-30	7. 2	7. 2	0	. 60	. 075	8. 0
Profile No. 9, Walla Walla silt loam (S57-Ore-28-5):								
57309	A1p	0-7	5. 9	5. 9	0	1. 25	. 094	13. 3
57310	A1pm	7-8½	6. 1	6. 3	0	1. 01	. 091	11. 1
57311	A12	8½-17	6. 4	6. 3	0	. 72	. 073	9. 9
57312	B21	17-25	6. 7	6. 7	0	. 46	. 057	8. 1
57313	B22	25-34	7. 1	6. 9	0	. 37	. 049	7. 6
57314	C1	34-50	7. 3	7. 2	0	. 25	----------	------
57315	C2	50-66	7. 4	7. 0	0	. 15	----------	------
57316	C3	66-76	7. 7	7. 4	0	. 13	----------	------
57317	C4ca	76-106	7. 9	8. 3	0	. 08	----------	------
57318	C5	106-116	8. 0	8. 1	([2])	. 04	----------	------
Profile No. 10, Walla Walla silt loam, coarse solum (S57-Ore-33-5):								
57210	Ap	0-7	6. 4	6. 2	0	. 93	. 070	13. 3
57211	A12	7-13	6. 6	6. 4	0	. 63	. 064	9. 8
57212	B21	13-20	6. 8	6. 5	0	. 52	. 056	9. 3
57213	B22	20-31	7. 0	6. 7	0	. 30	----------	------
57214	C1	31-44	7. 1	7. 0	0	. 25	----------	------
57215	C2	44-55	7. 4	6. 9	0	. 15	----------	------
57216	C3	55-82	7. 4	7. 1	0	. 09	----------	------
57217	C4	82-104	7. 6	7. 1	0	. 04	----------	------
Profile No. 11, Walla Walla silt loam, coarse solum (S57-Ore-28-6):								
57319	A1p	0-8	6. 4	6. 6	0	. 80	. 065	12. 3
57320	A1pm	8-10	6. 6	6. 6	0	. 66	. 066	10. 0
57321	A12	10-18	6. 9	6. 8	0	. 50	. 061	8. 2
57322	B2	18-32	7. 0	7. 0	0	. 38	. 049	7. 8
57323	C1	32-49	7. 2	6. 9	0	. 25	----------	------
57324	C2ca	49-63	8. 0	8. 1	3	. 21	----------	------
57325	C3ca	63-79	8. 2	8. 5	5	. 14	----------	------
57326	C4ca	79-103	8. 4	8. 6	2	. 08	----------	------
57327	C5ca	103-110	8. 6	8. 8	16	. 17	----------	------
Profile No. 12, Walla Walla silt loam, coarse solum (S57-Ore-28-7):								
57328	A1p	0-7	7. 2	7. 6	0	. 72	. 064	11. 3
57329	A12	7-13	6. 7	7. 1	0	. 64	. 061	10. 5
57330	B21	13-19	6. 7	6. 9	0	. 45	. 056	8. 0
57331	B22	19-30	6. 9	7. 2	0	. 34	----------	------
57332	C1	30-46	7. 5	7. 4	0	. 25	----------	------
57333	C2	46-60	7. 9	8. 0	0	. 12	----------	------
57334	C3ca	60-66	8. 8	9. 2	3	. 10	----------	------
57335	C4ca	66-83	8. 8	9. 2	1	. 04	----------	------
57336	C5ca	83-91	8. 9	9. 3	13	. 13	----------	------

[1] The organic-matter content of soils is ordinarily obtained by multiplying the organic-carbon content by 1.72 (*2*).

profiles from Sherman and Wasco Counties, Oreg.—Continued

Electrical conductivity (Ecx10³)	Cation exchange capacity (NaAc)	Extractable cations (meq./100 gm.)					Base saturation	Saturation extract soluble (meq./l.)							Moisture at saturation
		Ca	Mg	H	Na	K		Na	K	Ca	Mg	Cl	CO_3	HCO_3	
mmhos. per cm. at 25° C.							*Pct.*								*Pct.*
0. 3	27. 0	11. 7	6. 1	4. 4	0. 1	0. 9	81	0. 6	0. 2	1. 6	1. 2	0. 3	0	2. 1	38. 3
. 3	28. 1	11. 9	6. 0	4. 5	. 3	. 8	81	. 9	. 2	1. 4	1. 1	. 2	0	1. 9	38. 4
. 3	29. 7	19. 7	4. 1	3. 7	. 3	. 8	87	. 9	. 2	1. 7	1. 7	. 2	0	2. 5	44. 6
. 3	30. 7	18. 7	8. 7	3. 5	. 3	. 6	90	. 9	. 1	1. 4	1. 3	. 2	0	2. 1	47. 2
. 3	27. 2	18. 4	6. 9	2. 6	. 4	. 5	91	. 9	. 1	1. 4	1. 4	. 1	0	2. 1	36. 8
. 4	27. 0	16. 7	9. 5	2. 5	. 4	. 5	92	. 9	. 1	1. 7	. 9	. 3	0	2. 3	38. 9
. 2	16. 9	9. 1	3. 7	3. 7	. 4	1. 0	79	. 5	. 3	1. 1	. 7	. 3	0	1. 4	34. 9
. 3	17. 5	9. 4	3. 8	2. 9	. 6	. 8	83	. 4	. 3	1. 3	. 9	. 3	0	1. 3	36. 0
. 2	18. 0	10. 4	4. 5	2. 5	. 4	. 6	86	. 4	. 2	1. 7	. 9	. 2	0	1. 8	44. 3
. 3	17. 6	10. 9	4. 8	2. 0	. 2	. 5	89	. 5	. 1	1. 6	1. 0	. 1	0	1. 9	37. 8
. 4	17. 2	11. 7	5. 3	1. 1	. 6	. 7	89	. 6	. 1	2. 6	1. 6	. 1	0	2. 7	37. 9
. 4	19. 2	9. 6	3. 7	3. 9	. 3	1. 4	79	. 4	. 7	1. 5	. 9	. 3	0	1. 5	33. 1
. 2	19. 4	10. 5	4. 3	3. 4	. 5	1. 1	83	. 3	. 3	1. 2	. 6	. 1	0	1. 3	37. 0
. 3	20. 5	11. 3	5. 2	2. 1	. 2	1. 0	89	. 4	. 3	1. 8	1. 2	. 4	0	2. 2	38. 8
. 4	19. 8	11. 6	5. 6	1. 2	. 4	. 9	94	. 5	. 3	2. 2	1. 8	. 4	0	3. 1	39. 1
. 3	17. 3	8. 3	2. 2	5. 6	. 2	1. 5	69	. 2	1. 3	1. 2	. 8	. 3	0	1. 7	33. 4
. 3	17. 5	8. 8	2. 4	4. 7	. 2	1. 5	73	. 3	. 9	1. 0	. 7	. 1	0	1. 9	35. 3
. 2	16. 9	8. 6	2. 5	3. 6	. 2	1. 3	78	. 3	. 7	1. 2	. 7	. 2	0	1. 8	36. 7
. 3	15. 3	8. 4	2. 9	2. 6	. 3	1. 0	83	. 3	. 5	1. 6	1. 0	. 3	0	1. 8	34. 4
. 3	14. 6	8. 1	3. 4	1. 8	. 3	. 7	87	. 3	. 3	1. 6	1. 0	. 2	0	2. 0	35. 9
. 2	13. 8	7. 2	3. 8	1. 7	. 8	1. 4	89	. 4	. 2	. 9	. 8	. 1	0	1. 7	32. 8
. 1	13. 9	6. 4	4. 3	1. 2	. 6	1. 4	91	. 5	. 1	. 8	. 6	. 1	0	1. 4	33. 6
. 3	12. 6	7. 5	4. 5	. 8	. 8	1. 3	95	1. 0	. 1	1. 1	1. 1	. 1	0	2. 6	30. 6
. 3	13. 7	11. 6	5. 4	. 1	. 9	1. 2	99	1. 4	. 1	1. 1	1. 1	. 1	0	2. 8	33. 2
. 4	12. 6	10. 3	4. 1	. 2	1. 0	. 9	99	1. 9	. 1	1. 2	1. 0	. 3	0	3. 5	30. 9
. 1	15. 2	7. 7	1. 7	3. 6	. 1	1. 0	74	. 5	. 4	. 5	. 4	. 2	0	2. 1	31. 9
. 1	14. 8	7. 7	2. 0	3. 0	. 2	. 8	78	. 3	. 3	. 7	. 5	. 2	0	1. 7	33. 4
. 1	14. 2	7. 0	2. 6	2. 3	. 1	. 8	82	. 3	. 2	. 7	. 6	. 2	0	1. 6	33. 6
. 1	13. 6	6. 2	2. 8	1. 8	. 1	. 8	85	. 4	. 3	. 6	. 6	. 2	0	1. 5	31. 8
. 1	12. 3	6. 1	2. 7	1. 5	. 2	1. 7	88	. 2	. 3	. 4	. 9	. 2	0	1. 7	31. 3
. 1	11. 8	6. 0	2. 9	1. 2	. 2	1. 5	90	. 3	. 3	. 6	. 6	. 2	0	1. 7	31. 0
------------	11. 8	6. 0	3. 4	1. 4	. 2	1. 3	89	. 3	. 2	. 5	. 5	. 1	0	1. 5	30. 8
. 2	11. 4	6. 0	3. 7	. 7	. 3	1. 0	94	. 5	. 2	. 7	. 6	. 1	0	1. 1	32. 9
. 3	13. 0	8. 9	2. 4	2. 8	. 2	1. 0	82	. 3	. 5	1. 5	. 7	. 2	0	2. 0	30. 9
. 2	14. 0	9. 9	2. 3	2. 2	. 2	. 8	86	. 3	. 4	1. 6	. 5	. 2	0	1. 9	35. 4
. 3	13. 8	10. 0	2. 4	1. 9	. 2	. 7	88	. 3	. 3	1. 8	. 8	. 2	0	2. 5	35. 5
. 2	13. 0	9. 4	2. 7	1. 6	. 3	. 6	89	. 2	. 2	1. 5	. 6	. 1	0	2. 1	34. 4
. 2	10. 6	7. 6	2. 8	. 8	. 5	. 8	94	. 3	. 1	1. 5	. 8	. 1	0	2. 3	34. 0
. 3	12. 6	20. 4	2. 9	------	. 8	. 7	100	. 4	. 1	2. 1	1. 0	. 1	0	3. 2	34. 2
. 3	9. 3	19. 6	3. 9	------	. 6	. 5	100	. 6	. 1	1. 5	1. 4	. 1	0	2. 9	33. 7
. 4	11. 1	18. 5	5. 6	------	1. 4	. 4	100	2. 2	. 1	1. 0	1. 4	. 2	0	3. 7	30. 8
. 4	10. 4	20. 6	4. 6	------	1. 5	. 3	100	3. 2	. 1	. 6	1. 2	. 2	0	4. 4	36. 9
. 5	11. 6	8. 0	2. 5	1. 7	. 3	1. 1	88	. 5	. 9	2. 7	1. 4	. 2	0	5. 2	30. 3
. 2	14. 2	9. 4	3. 3	1. 3	. 2	. 7	91	. 2	. 3	1. 5	. 7	. 1	0	2. 3	31. 1
. 2	14. 7	9. 4	3. 5	3. 0	. 2	. 6	82	. 4	. 2	1. 2	. 8	. 1	0	1. 8	35. 1
. 2	16. 5	9. 4	3. 9	2. 3	. 3	. 5	86	. 3	. 1	1. 2	. 6	. 1	0	1. 7	37. 7
. 2	15. 1	8. 6	4. 8	1. 1	. 7	. 5	93	. 5	. 1	1. 1	1. 0	. 1	0	2. 0	34. 6
. 5	13. 2	6. 5	5. 2	. 6	1. 9	. 4	96	3. 2	. 1	. 8	. 7	. 5	0	3. 8	29. 6
. 8	13. 0	21. 0	4. 7	------	5. 0	. 3	100	7. 3	. 1	. 4	1. 1	. 5	0	7. 7	30. 8
. 8	14. 5	19. 9	4. 0	------	5. 8	. 3	100	8. 1	. 1	. 4	. 7	. 5	1. 0	7. 1	32. 4
. 9	14. 2	21. 0	6. 1	------	4. 8	. 3	100	8. 1	. 1	. 5	1. 0	. 9	1. 4	6. 4	32. 4

[2] Trace.

TABLE 9.—*Particle-size distribution in 12 soils from Sherman and Wasco Counties*

Profile number, soil type, and sample number	Horizon	Depth	Large separates (greater than 2 mm.)	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Coarse silt (0.05–0.02 mm.)	Fine silt (0.02–0.002 mm.)	Clay (less than 0.002 mm.)
Profile No. 1, Condon silt loam (S57–Ore–33–10):		*In.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
57246	Ap	0–7	0	0.4	1.5	2.5	11.3	7.0	31.0	31.5	14.8
57247	B1	7–10	0	1.2	1.5	2.4	9.9	6.6	29.3	30.5	18.6
57248	B2	10–18	0	1.4	1.6	2.0	8.4	5.9	31.1	28.8	20.8
57249	B3	18–24	3	1.9	2.5	2.4	9.1	6.6	32.9	29.3	15.3
Profile No. 2, Condon silt loam (S57–Ore–33–11):											
57251	Ap	0–7	1	.9	2.9	3.2	11.2	7.3	28.4	30.1	16.0
57252	B1	7–10	0	.9	1.7	2.0	8.5	6.6	30.6	32.3	17.4
57253	B2	10–18	0	1.0	1.3	1.5	7.2	6.2	30.3	30.5	22.0
57254	B3	18–29	1	1.0	1.3	1.6	6.6	6.3	32.4	34.6	16.2
Profile No. 3, Condon silt loam (S57–Ore–28–1):											
57295	A11	0–4½	0	.4	1.1	1.8	8.0	7.5	31.5	36.1	13.6
57296	A12	4½–11	0	.2	1.0	2.0	8.1	7.1	29.3	34.7	17.6
57297	B2	11–18	0	.2	.7	1.9	8.2	7.4	30.6	35.0	16.0
57298	B3	18–26	6	.8	1.8	2.8	9.0	7.9	30.7	34.7	12.3
Profile No. 4, Lickskillet very stony loam (S57–Ore–28–8):											
57337	A1	0–5	9	2.8	7.4	4.7	10.1	9.0	26.8	24.4	14.8
57338	B1	5–9	8	4.0	7.5	4.5	8.3	8.2	20.7	26.7	20.1
57339	B2	9–20	7	5.5	7.6	3.1	6.7	7.3	25.0	21.8	23.0
Profile No. 5, Lickskillet extremely stony loam (S57–Ore–28–9):											
57341	A1	0–4	31	7.7	11.5	6.7	16.9	10.8	17.5	18.1	10.8
57342	B1	4–9	26	8.3	12.1	5.3	12.4	10.0	18.5	17.3	16.1
57343	B21	9–14	31	8.2	10.9	5.2	11.4	9.2	15.3	14.8	25.0
57344	B22	14–21	39	12.7	12.2	5.0	10.3	9.1	13.4	12.1	25.2
Profile No. 6, Condon silt loam (S57–Ore–33–12):											
57256	A1p	0–4	0	.4	1.1	1.8	10.2	5.9	24.0	38.3	18.3
57257	A12	4–8	0	.6	1.0	1.7	10.2	6.5	25.1	36.4	18.5
57258	B21	8–14	0	.3	.8	1.5	8.5	5.3	24.8	34.7	24.1
57259	B22	14–19	0	.3	.9	1.5	7.0	5.6	27.4	33.8	23.5
57260	B3	19–21	3	1.6	3.0	3.8	15.4	9.6	21.9	29.4	15.3
57261	C	21–23	28	2.8	4.9	5.5	20.1	8.6	15.7	22.4	20.0
Profile No. 7, Walla Walla silt loam (S57–Ore–28–2):											
57299	A1p	0–8	0	.1	.8	2.5	8.5	16.4	38.8	22.8	10.1
57300	A1pm	8–9½	0	.1	.5	2.3	7.9	16.4	38.6	21.6	12.6
57301	A12	9½–16	0	.2	.6	2.2	7.6	16.1	38.1	23.6	11.6
57302	B21	16–24	0	.2	.5	1.8	6.7	15.2	40.9	23.6	11.1
57303	B22	24–37	0	.3	.4	1.3	5.9	15.9	42.2	24.3	9.7
Profile No. 8, Walla Walla silt loam (S57–Ore–28–3):											
57305	A1p	0–8	2	.6	.9	1.9	9.0	11.7	34.1	27.0	14.8
57306	A1pm	8–9½	1	1.1	1.4	2.2	8.6	11.3	35.2	26.7	13.5
57307	B21	9½–18	2	.6	.8	1.7	8.0	10.9	38.6	27.1	12.3
57308	B22	18–30	3	1.0	1.0	1.8	7.5	12.2	37.9	27.6	11.0
Profile No. 9, Walla Walla silt loam (S57–Ore–28–5):											
57309	A1p	0–7	0	.1	.5	2.5	9.1	17.4	38.2	19.8	12.4
57310	A1pm	7–8½	0	0	.3	1.9	7.1	18.0	38.0	22.3	12.4
57311	A12	8½–17	0	0	.3	1.9	6.8	17.3	38.4	22.4	12.9
57312	B21	17–25	0	0	.2	1.3	6.2	17.0	40.6	22.8	11.9
57313	B22	25–34	0	0	.2	1.1	5.3	18.3	40.9	22.9	11.3
57314	C1	34–50	0	.1	.2	1.3	6.2	19.4	41.3	20.5	11.0
57315	C2	50–66	0	0	.5	1.4	7.6	24.4	41.6	15.8	8.7
57316	C3	66–76	0	0	.8	2.7	9.0	24.4	39.3	19.9	3.9
57317	C4ca	76–106	0	.1	.2	.6	4.1	26.1	49.6	16.0	3.3
57318	C5	106–116	0	0	.2	.6	3.4	26.4	51.1	14.7	3.6

TABLE 9.—*Particle-size distribution in 12 soils from Sherman and Wasco Counties*—Continued

Profile number, soil type, and sample number	Horizon	Depth	Large separates (greater than 2 mm.)	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Coarse silt (0.05–0.02 mm.)	Fine silt (0.02–0.002 mm.)	Clay (less than 0.002 mm.)
Profile No. 10, Walla Walla silt loam, coarse solum (S57–Ore–33–5):		*In.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
57210	Ap	0–7	0	0	0.5	1.4	5.2	22.9	42.7	18.2	9.1
57211	A12	7–13	0	0	.5	1.6	4.7	20.5	43.9	18.9	9.9
57212	B21	13–20	0	.1	.4	1.5	4.6	22.7	43.9	17.3	9.5
57213	B22	20–31	0	.1	.3	1.6	4.5	23.1	46.3	16.5	7.6
57214	C1	31–44	0	.1	.5	1.9	4.8	22.9	46.4	16.0	7.4
57215	C2	44–55	0	.1	.3	1.5	4.6	23.5	45.9	17.0	7.1
57216	C3	55–82	0	.1	.3	.7	3.5	24.0	48.1	15.7	7.6
57217	C4	82–104	0	.1	.1	.7	3.2	29.2	47.2	13.1	6.4
Profile No. 11, Walla Walla silt loam, coarse solum (S57–Ore–28–6):											
57319	A1p	0–8	0	.1	.4	2.1	6.1	26.0	42.0	12.7	10.6
57320	A1pm	8–10	0	.1	.4	2.3	5.8	24.8	41.5	14.3	10.8
57321	A12	10–18	0	.1	.3	1.8	5.6	23.5	42.9	13.6	12.2
57322	B2	18–32	0	.1	.2	1.0	3.7	22.8	45.7	15.3	11.2
57323	C1	32–49	0	.1	.1	.3	2.4	27.0	48.9	13.5	7.7
57324	C2ca	49–63	0	.1	.1	.7	4.5	32.8	43.8	13.7	4.3
57325	C3ca	63–79	0	0	.3	1.3	9.3	42.2	33.3	8.8	4.8
57326	C4ca	79–103	0	0	.5	2.4	9.1	37.0	37.9	9.6	3.5
57327	C5ca	103–110	0	.6	2.1	2.1	6.7	32.0	40.5	11.7	4.3
Profile No. 12, Walla Walla silt loam, coarse solum (S57–Ore–28–7):											
57328	A1p	0–7	0	0	.8	5.5	12.8	29.2	33.3	8.3	10.1
57329	A12	7–13	0	0	.4	2.8	8.1	23.2	38.4	14.3	12.8
57330	B21	13–19	0	0	.2	2.1	7.1	21.3	39.7	15.1	14.5
57331	B22	19–30	0	0	.2	1.1	5.1	20.7	42.0	17.6	13.3
57332	C1	30–46	0	0	.1	.8	5.3	27.1	41.7	15.0	10.0
57333	C2	46–60	0	.1	.3	2.0	13.0	35.1	32.1	9.4	8.0
57334	C3ca	60–66	0	.2	.6	3.0	16.5	40.1	28.3	6.3	5.0
57335	C4ca	66–83	0	.1	.7	2.8	14.0	39.4	31.8	7.5	3.7
57336	C5ca	83–91	0	.3	1.9	3.5	13.2	33.5	31.0	9.2	7.4

Table 10.—*Physical properties of 12 selected soil profiles from Sherman and Wasco Counties, Oreg.*

Profile number, soil type, and sample number	Horizon	Depth	Bulk density	Moisture held at tensions of—			Inches of available moisture in horizon	Ratio of fine silt to coarse silt	Total sand	Sand fractions as percent of total sand—				
				1/10 atmosphere	1/3 atmosphere	15 atmospheres				Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand
Profile No. 1, Condon silt loam (S57-Ore-33-10):		*In.*	*Gm./cu. cm*	*Pct.*	*Pct.*	*Pct.*			*Pct.*					
57246	Ap	0–7	1. 42	34. 4	25. 8	8. 3	1. 73	1. 02	22. 7	1. 8	6. 6	11. 0	49. 8	30. 8
57247	B1	7–10	1. 38	38. 2	23. 6	9. 6	. 57	1. 04	21. 6	5. 6	6. 9	11. 1	45. 8	30. 6
57248	B2	10–18	1. 39	37. 0	28. 1	10. 2	2. 00	. 93	19. 3	7. 3	8. 3	10. 4	43. 5	30. 6
57249	B3	18–24	------	32. 4	26. 2	9. 1	------	. 89	22. 5	8. 4	11. 1	10. 7	40. 4	29. 3
Profile No. 2, Condon silt loam (S57-Ore-33-11):														
57251	Ap	0–7	1. 23	30. 1	24. 7	8. 5	1. 39	1. 06	25. 5	3. 5	11. 4	12. 5	43. 9	28. 6
57252	B1	7–10	1. 31	35. 2	26. 2	9. 0	. 75	1. 06	19. 7	4. 6	8. 6	10. 2	43. 1	33. 5
57253	B2	10–18	1. 35	38. 4	27. 3	11. 1	1. 75	1. 01	17. 2	5. 8	7. 6	8. 7	41. 9	36. 0
57254	B3	18–29	1. 39	35. 7	27. 2	9. 3	2. 74	1. 07	16. 8	6. 0	7. 7	9. 5	39. 3	37. 5
Profile No. 3, Condon silt loam (S57-Ore-28-1):														
57295	A11	0–4½	1. 18	50. 4	30. 3	9. 1	1. 13	1. 15	18. 8	2. 1	5. 8	9. 6	42. 6	39. 9
57296	A12	4½–11	1. 26	38. 4	24. 0	9. 2	1. 21	1. 18	18. 4	1. 1	5. 4	10. 9	44. 0	38. 6
57297	B2	11–18	1. 17	36. 4	25. 4	9. 3	1. 32	1. 14	18. 4	1. 1	3. 8	10. 3	44. 6	40. 2
57298	B3	18–26	1. 35	33. 9	25. 7	8. 6	1. 85	1. 13	22. 3	3. 6	8. 1	12. 6	40. 4	35. 4
Profile No. 4, Lickskillet very stony loam (S57-Ore-28-8):														
57337	A1	0–5	1. 60	32. 7	23. 6	9. 4	1. 14	. 91	34. 0	8. 2	21. 8	13. 8	29. 7	26. 5
57338	B1	5–9	1. 40	35. 7	25. 6	10. 9	. 82	1. 29	32. 5	12. 3	23. 1	13. 8	25. 5	25. 2
57339	B2	9–20	1. 43	37. 7	27. 3	12. 6	2. 31	. 87	30. 2	18. 2	25. 2	10. 3	22. 2	24. 2
Profile No. 5, Lickskillet extremely stony loam (S57-Ore-28-9):														
57341	A1	0–4	------	29. 6	18. 2	8. 1	------	1. 03	53. 6	14. 4	21. 4	12. 5	31. 5	20. 1
57342	B1	4–9	------	33. 7	22. 6	9. 5	------	. 94	48. 1	17. 3	25. 2	11. 0	25. 8	20. 8
57343	B21	9–14	------	36. 3	27. 5	14. 4	------	. 97	44. 9	18. 3	24. 3	11. 6	25. 4	20. 5
57344	B22	14–21	------	35. 5	29. 8	14. 3	------	. 90	49. 3	25. 8	24. 7	10. 1	20. 9	18. 5
Profile No. 6, Condon silt loam (S57-Ore-33-12):														
57256	A1p	0–4	1. 35	37. 3	29. 6	9. 4	. 79	1. 60	19. 4	2. 1	5. 7	9. 3	52. 6	30. 4
57257	A12	4–8	1. 35	38. 0	28. 4	10. 0	. 99	1. 45	20. 0	3. 0	5. 0	8. 5	51. 0	32. 5
57258	B21	8–14	1. 31	39. 5	29. 5	12. 6	1. 34	1. 40	16. 4	1. 8	4. 9	9. 1	51. 8	32. 3
57259	B22	14–19	1. 42	39. 5	31. 4	13. 5	1. 27	1. 23	15. 3	2. 0	5. 9	9. 8	45. 7	36. 6
57260	B3	19–21	------	35. 7	26. 6	11. 2	------	1. 34	33. 4	4. 8	9. 0	11. 4	46. 1	28. 7
57261	C	21–23	------	34. 8	26. 1	12. 0	------	1. 43	41. 9	6. 7	11. 7	13. 1	48. 0	20. 5
Profile No. 7, Walla Walla silt loam (S57-Ore-28-2):														
57299	A1p	0–8	------	32. 3	18. 8	6. 5	------	. 59	28. 3	. 4	2. 8	8. 8	30. 0	57. 9
57300	A1pm	8–9½	1. 47	33. 5	18. 9	6. 7	. 27	. 56	27. 2	. 4	1. 8	8. 5	29. 0	60. 3
57301	A12	9½–16	1. 43	35. 6	18. 9	6. 8	1. 13	. 62	26. 7	. 7	2. 2	8. 2	28. 5	60. 3
57302	B21	16–24	1. 34	34. 3	19. 2	6. 7	1. 34	. 58	24. 4	. 8	2. 0	7. 4	27. 5	62. 3
57303	B22	24–37	1. 38	33. 3	20. 2	5. 9	2. 56	. 58	23. 8	1. 3	1. 7	5. 5	24. 8	66. 8
Profile No. 8, Walla Walla silt loam (S57-Ore-28-3):														
57305	A1p	0–8	1. 15	34. 8	21. 9	7. 4	1. 33	. 79	24. 1	2. 5	3. 7	7. 9	37. 3	48. 5
57306	A1pm	8–9½	1. 40	33. 5	21. 2	7. 7	. 28	. 76	24. 6	4. 5	5. 7	8. 9	35. 0	45. 9
57307	B21	9½–18	1. 28	34. 7	21. 9	7. 5	1. 57	. 70	22. 0	2. 7	3. 6	7. 7	36. 4	49. 5
57308	B22	18–30	1. 22	33. 8	22. 8	7. 2	2. 28	. 72	23. 5	4. 3	4. 3	7. 7	31. 9	51. 9

Profile No. 9, Walla Walla silt loam (S57–Ore–28–5):														
57309	A1p	0–7	1. 03	35. 2	19. 6	6. 3	. 96	. 52	29. 4	. 3	1. 7	8. 5	30. 9	59. 2
57310	A1pm	7–8½	1. 19	35. 9	19. 1	6. 6	. 22	. 59	27. 3	0	1. 1	7. 0	26. 0	65. 9
57311	A12	8½–17	1. 37	36. 8	22. 4	6. 4	1. 86	. 58	26. 3	0	1. 1	7. 2	25. 9	65. 8
57312	B21	17–25	1. 36	34. 1	18. 1	6. 0	1. 32	. 56	24. 7	0	. 8	5. 3	25. 1	68. 8
57313	B22	25–34	1. 39	34. 0	19. 0	5. 7	1. 66	. 56	24. 9	0	. 8	4. 4	21. 3	73. 4
57314	C1	34–50	1. 44	33. 5	18. 5	5. 2	3. 06	. 50	27. 2	. 4	. 7	4. 8	22. 8	71. 3
57315	C2	50–66	1. 42	32. 5	17. 7	5. 8	2. 70	. 38	33. 9	0	1. 5	4. 1	22. 4	72. 0
57316	C3	66–76	1. 33	32. 3	17. 7	5. 7	1. 60	. 51	36. 9	0	2. 2	7. 3	24. 4	66. 1
57317	C4ca	76–106	--------	33. 4	16. 8	5. 4	----------	. 32	31. 1	. 3	. 6	1. 9	13. 2	83. 9
57318	C5	106–116	--------	32. 0	16. 3	4. 8	----------	. 29	30. 6	0	. 7	2. 0	11. 1	86. 2
Profile No. 10, Walla Walla silt loam, coarse solum (S57–Ore–33–5):														
57210	Ap	0–7	1. 35	34. 6	17. 6	6. 8	1. 02	. 43	30. 0	0	1. 7	4. 7	17. 3	76. 3
57211	A12	7–13	1. 33	38. 2	16. 6	6. 9	. 77	. 43	27. 3	0	1. 8	5. 9	17. 2	75. 1
57212	B21	13–20	1. 23	38. 3	15. 5	5. 7	. 84	. 39	29. 3	. 3	1. 4	5. 1	15. 7	77. 5
57213	B22	20–31	1. 23	36. 1	14. 6	5. 3	1. 26	. 36	29. 6	. 3	1. 0	5. 4	15. 2	78. 0
57214	C1	31–44	1. 31	35. 0	14. 1	5. 2	1. 51	. 34	30. 2	. 3	1. 7	6. 3	15. 9	75. 8
57215	C2	44–55	1. 42	35. 0	14. 6	5. 3	1. 45	. 37	30. 0	. 3	1. 0	5. 0	15. 3	78. 3
57216	C3	55–82	1. 29	35. 1	15. 2	4. 8	3. 62	. 33	28. 6	. 3	1. 0	2. 4	12. 2	83. 9
57217	C4	82–104	1. 32	34. 7	13. 7	4. 3	2. 73	. 28	33. 3	. 3	. 3	2. 1	9. 6	87. 7
Profile No. 11, Walla Walla silt loam, coarse solum (S57–Ore–28–6):														
57319	A1p	0–8	1. 28	32. 8	15. 4	5. 4	1. 02	. 30	34. 7	. 3	1. 2	6. 1	17. 6	74. 9
57320	A1pm	8–10	1. 34	33. 4	15. 3	5. 7	. 26	. 34	33. 4	. 3	1. 2	6. 9	17. 4	74. 3
57321	A12	10–18	1. 27	33. 5	14. 9	5. 8	. 92	. 32	31. 3	. 3	1. 0	5. 7	17. 9	75. 1
57322	B2	18–32	1. 34	33. 6	15. 8	5. 6	1. 91	. 33	27. 8	. 4	. 7	3. 6	13. 3	82. 0
57323	C1	32–49	1. 43	32. 4	14. 3	4. 3	2. 43	. 28	29. 9	. 3	. 3	1. 0	8. 0	90. 3
57324	C2ca	49–63	1. 31	34. 3	15. 0	4. 8	1. 87	. 31	38. 2	. 3	. 3	1. 8	11. 8	85. 8
57325	C3ca	63–79	1. 40	33. 1	11. 9	5. 2	1. 50	. 26	53. 1	0	. 6	2. 4	17. 5	79. 5
57326	C4ca	79–103	1. 47	30. 7	13. 2	4. 6	----------	. 25	49. 0	0	1. 0	4. 9	18. 6	75. 5
57327	C5ca	103–110	--------	36. 4	20. 1	7. 5	----------	. 29	43. 5	1. 4	4. 8	4. 8	15. 4	73. 5
Profile No. 12, Walla Walla silt loam, coarse solum (S57–Ore–28–7):														
57328	A1p	0–7	1. 43	31. 2	12. 0	5. 0	. 70	. 25	48. 3	0	1. 7	11. 4	26. 5	60. 4
57329	A12	7–13	1. 36	31. 8	15. 2	6. 2	. 73	. 37	34. 5	0	1. 2	8. 1	23. 5	67. 2
57330	B21	13–19	1. 25	32. 8	13. 7	6. 5	. 54	. 38	30. 7	0	. 7	6. 8	23. 1	69. 3
57331	B22	19–30	1. 43	33. 5	17. 4	6. 4	1. 73	. 42	27. 1	0	. 7	4. 1	18. 8	76. 4
57332	C1	30–46	1. 42	31. 5	16. 4	5. 3	2. 52	. 36	33. 3	0	. 3	2. 4	15. 9	81. 4
57333	C2	46–60	1. 55	29. 1	12. 6	5. 2	1. 61	. 29	50. 5	. 2	. 6	4. 0	25. 7	69. 5
57334	C3ca	60–66	1. 52	28. 1	12. 5	5. 5	. 64	. 22	60. 4	. 3	1. 0	5. 0	27. 3	66. 4
57335	C4ca	66–83	1. 45	32. 5	12. 1	5. 4	----------	. 24	56. 9	. 2	1. 2	4. 9	24. 5	69. 2
57336	C5ca	83–91	--------	33. 0	17. 7	8. 3	----------	. 30	52. 4	. 6	3. 6	6. 7	25. 2	63. 9

TABLE 11.—*Mineralogical composition of the 20- to 50-micron fraction of selected horizons of the Walla Walla and Condon soils*

HEAVY MINERALS

Soil type, survey number, and selected horizons	Total	Horn-blende	Basalt horn-blende	Enstatite	Epidote	Sphene	Magnetite	Augite	Zircon
	Percent by weight of 20- to 50-micron fraction	*Percent, by number of grains, of total heavy minerals*							
Walla Walla silt loam, (S57-Ore-28-5-(1-10):									
A1p (0 to 7 inches)	25	18. 5	3. 3	12. 4	8. 4	7. 2	39. 4	2. 9	--------
C11 (34 to 50 inches)	25	15. 7	--------	22. 8	7. 7	4. 4	32. 2	12. 1	--------
C13 (66 to 76 inches)	30	22. 8	--------	11. 7	8. 1	4. 2	35. 5	9. 1	--------
Cca (76 to 106 inches)	20	27. 9	--------	12. 7	5. 9	4. 2	33. 0	8. 9	--------
Condon silt loam, (S57-Ore-33-10-(1-5):									
Ap (0 to 7 inches)	20	18. 0	9. 1	6. 8	8. 6	3. 5	41. 1	6. 8	--------
B1 (7 to 10 inches)	25	20. 5	9. 3	8. 3	6. 5	3. 5	39. 4	5. 6	--------
B2 (10 to 18 inches)	15	28. 0	6. 6	7. 6	8. 8	3. 3	38. 9	--------	--------
B3 (18 to 24 inches)	20	29. 1	6. 3	7. 0	10. 2	1. 7	38. 4	--------	5. 5
Condon silt loam, (S57-Ore-33-12-(1-7):									
A1p (0 to 4 inches)	20	26. 0	4. 3	9. 7	7. 3	2. 3	40. 0	3. 3	5. 0
B21 (8 to 14 inches)	1	--------	--------	--------	--------	--------	--------	--------	--------
B3 (19 to 21 inches)	15	17. 7	5. 8	13. 0	13. 0	6. 7	37. 1	--------	4. 6
C (21 to 23 inches)	20	29. 0	2. 6	7. 4	11. 3	7. 4	35. 1	--------	3. 5

LIGHT MINERALS

Soil type, survey number, and selected horizons	Total	Quartz	Feldspar	Muscovite	Glass	Biotite	Aggregates
	Percent by weight of 20- to 50-micron fraction	*Percent, by number of grains, of total light minerals*					
Walla Walla silt loam (S57-Ore-28-5-(1-10)):							
Alp (0 to 7 inches)	75	18. 7	15. 7	18. 7	2. 3	3. 7	40. 9
C11 (34 to 50 inches)	75	30. 8	18. 6	13. 2	4. 2	7. 3	26. 0
C13 (66 to 76 inches)	70	8. 8	8. 8	24. 9	1. 6	2. 9	52. 8
Cca (76 to 106 inches)	80	9. 5	9. 7	25. 6	--------	2. 6	52. 5
Condon silt loam (S57-Ore-33-10-(1-5)):							
Ap (0 to 7 inches)	80	17. 1	23. 6	15. 4	6. 6	6. 1	31. 3
B1 (7 to 10 inches)	75	19. 9	22. 8	12. 4	4. 9	4. 9	34. 7
B2 (10 to 18 inches)	85	22. 8	17. 0	13. 6	2. 6	3. 1	40. 8
B3 (18 to 24 inches)	80	21. 5	29. 9	13. 0	1. 4	6. 1	27. 8
Condon silt loam (S57-Ore-32-12-(1-7)):							
A1p (0 to 4 inches)	80	17. 5	11. 5	13. 1	6. 6	4. 6	46. 7
B21 (8 to 14 inches)	99	25. 1	29. 2	12. 4	5. 0	4. 3	24. 1
B3 (19 to 21 inches)	85	28. 6	21. 3	15. 7	9. 1	6. 2	19. 2
C (21 to 23 inches)	80	33. 4	14. 5	17. 1	8. 2	6. 1	20. 7

Profile No. 1—Condon silt loam (S57–Ore–33–10–1 through 4), 185 feet north of edge of county road from Maupin to Bakeoven, SW¼NW¼SE¼ sec. 30, T. 4 S., R. 15 E., Wasco County.

Ap—0 to 7 inches, grayish-brown (10YR 5.5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure breaking to weak, medium, granular; slightly hard, friable, slightly sticky and slightly plastic; abundant roots; many, fine, interstitial pores; weak, fine to very fine vesicles in uppermost half inch; abrupt, smooth boundary.

B1—7 to 10 inches, dark-brown (10YR 3/3, moist) silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; abundant roots; many, fine, tubular pores; thin, patchy clay films on ped surfaces, pores clean; abrupt, smooth boundary.

B2—10 to 18 inches, dark-brown (10YR 3.5/3, moist) silt loam; dark-brown (10YR 3/3) clay films; weak medium, prismatic structure breaking to weak to moderate, subangular blocky; friable to firm, moderately sticky and moderately plastic; nearly continuous, moderately thick clay films on prisms and subangular blocks, no clay films in pores; abundant roots; many, fine, tubular pores; clear, smooth boundary.

B3—18 to 24 inches, dark yellowish-brown (10YR 3.5/3.5, moist) silt loam; weak, medium, prismatic structure breaking to weak to moderate, subangular blocky structure; friable to firm, moderately sticky and moderately plastic; many patchy, thin clay films on prisms and blocks, no films in pores; abundant roots; many, fine, tubular pores; abrupt, wavy boundary.

D—24 inches +, fragmented basalt stones underlain by basalt bedrock.

Profile No. 2—Condon silt loam (S57–Ore–33–11–1 through 4), 70 feet south of Bakeoven county road, 1.6 miles northwest of Wilson Road junction, NE¼NE¼ SW¼ sec. 2, T. 5 S., R. 15 E., Wasco County.

Ap—0 to 7 inches, grayish-brown (10YR 5.5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard, friable, slightly sticky and moderately plastic; abundant roots; many, fine, interstitial pores; vesicles in uppermost ½ to 1 inch; abrupt, smooth boundary.

B1—7 to 10 inches, dark grayish-brown (10YR 3/2.5, moist) silt loam; weak, medium, platy structure; firm, slightly sticky and moderately plastic; abundant roots; many, fine, tubular pores; thin, patchy clay films on peds, pores clean; clear, smooth boundary.

B2—10 to 18 inches, dark-brown (10YR 3/3, moist) heavy silt loam; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; friable to firm, moderately sticky and moderately plastic; abundant roots; many, fine, tubular pores; nearly continuous clay films on prisms, and thin, patchy films on blocks, pores nearly clean of clay films; clear, smooth boundary.

B3—18 to 29 inches, dark-brown (10YR 4/3, moist) silt loam; very weak, coarse, prismatic structure breaking to very weak, indistinct, medium, subangular blocky; friable, moderately sticky and moderately plastic; abundant roots; many, fine, tubular pores; few, thin, patchy clay films on blocks and in pores; abrupt, wavy boundary.

D—29 inches +, lime-coated basalt stones underlain by basalt bedrock.

Profile No. 3—Condon silt loam (S57–Ore–28–1 through 4), ⅛ mile east of section corner, 40 feet north of road, SW¼ sec. 28, T. 3 S., R. 17 E., Sherman County.

A11—0 to 4½ inches, very dark grayish-brown (10YR 2.5/2, moist) silt loam; moderate, thin to medium, platy structure breaking to weak, fine, granular; friable, slightly sticky and slightly plastic; abundant roots; many fine pores; abrupt, smooth boundary.

A12—4½ to 11 inches, very dark grayish-brown (10YR 3/2, moist) silt loam; weak, medium, prismatic structure and weak to moderate, medium, subangular blocky; friable, moderately sticky and plastic; abundant roots; many, fine, tubular pores; clear, smooth boundary.

B2—11 to 18 inches, dark-brown (10YR 3.5/3, moist) silt loam; weak to moderate, medium, prismatic structure and weak, medium, subangular blocky; friable, sticky and plastic; abundant roots; many, fine, tubular pores; many, thin, patchy clay films on ped surfaces and in larger pores; clear, smooth boundary.

B3—18 to 26 inches, dark-brown (10YR 4/3, moist) silt loam; weak to moderate, medium, prismatic structure and weak, medium, subangular blocky; friable, sticky and plastic; abundant roots; many, fine, patchy clay films on ped surfaces and in larger pores; abrupt, smooth boundary.

D—26 inches +, basalt bedrock.

Profile No. 4—Lickskillet very stony loam (S57–Ore–28–8–1 through 3), 0.2 mile east of section corner, 600 feet south, 15° east of road, NW¼NE¼NW¼ sec. 9, T. 4 S., R. 18 E., Sherman County. This profile is described on page 58.

Profile No. 5—Lickskillet extremely stony loam (S57–Ore–28–9–1 through 4), 200 feet downslope from road, NE¼SW¼NW¼ sec. 6, T. 4 S., R. 15 E., Sherman County.

A1—0 to 4 inches, brown (10YR 5/3) extremely stony loam; very dark grayish brown (9YR 3/2) when moist; weak, medium, platy structure breaking to weak, fine, granular; slightly hard, friable, slightly sticky and slightly plastic; abundant roots; common to few, fine, interstitial pores; abrupt, wavy boundary.

B1—4 to 9 inches, dark-brown (10YR 3/3, moist) extremely stony loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; abundant roots; common to few, fine, tubular pores; few, thin, patchy clay films on ped surfaces and in pores; abrupt, wavy boundary.

B21—9 to 14 inches, dark-brown (7.5YR 3/3, moist) extremely stony loam; moderate, medium, prismatic structure breaking to moderate, fine, subangular blocky; firm, sticky and plastic; roots common; common to few, fine, tubular pores; thin, continuous clay films on prisms and blocks and in pores; gradual, wavy boundary.

B22—14 to 22 inches, dark-brown (7.5YR 3/4, moist) extremely stony sandy clay loam; moderate, medium, prismatic structure breaking to moderate, fine, subangular blocky; firm, sticky and plastic; roots common; common to few, fine, tubular pores; thin, continuous films on prisms and blocks and in pores; abrupt, wavy boundary.

Dr—22 inches +, basalt bedrock.

Profile No. 6—Condon silt loam (S57–Ore–33–12–1 through 6), 1.3 miles southeast of Shaniko, Oregon, 200 feet east of road, N½SW¼SW¼ sec. 6, T. 7 S., R. 17 E., Wasco County.

A1p—0 to 4 inches, grayish-brown (10YR 5.5/2) silt loam, very dark brown (10YR 2.5/2) when moist; weak, thin, platy structure; slightly hard to hard, friable, slightly sticky and slightly plastic; abundant fine roots; many weak, coarse vesicles in uppermost three-quarter inch; common, fine pores to a depth of 4 inches; clear, smooth boundary.

A12—4 to 8 inches, very dark brown (10YR 2/2, moist) silt loam; weak, coarse, platy structure breaking to weak, fine, granular; slightly hard to hard, friable to firm, moderately sticky and moderately plastic; abundant fine roots; common, fine, tubular pores; abrupt, smooth boundary.

B21—8 to 14 inches, dark-brown (10YR 3/3, moist) heavy silt loam; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; firm, sticky and plastic, abundant, fine roots; common, fine and medium, tubular pores; very dark brown, thick, continuous clay films on prisms and blocky peds; thick, continuous clay films on interior granules in subangular blocks; clay films only in larger pores; abrupt, smooth boundary.

B22—14 to 19 inches, dark yellowish-brown (10YR 3/4, moist) heavy silt loam; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; friable to firm, sticky and plastic; abundant fine roots; common, fine and medium, tubular pores; thick, continuous clay films on prisms and blocky peds; thick, continuous clay films on interior granules in subangular blocks; clay films only in larger pores; clear, smooth boundary.

B3—19 to 21 inches, dark yellowish-brown (10YR 3.5/4, moist) silt loam; weak, fine, subangular blocky structure; friable to firm, very sticky and plastic; abundant fine roots; common, fine and medium, tubular pores; thick, patchy clay films; disseminated clay; clear, smooth boundary.

C—21 to 23 inches, dark yellowish-brown (10YR 3.5/4, moist) gravelly loam; massive to moderate, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; abundant fine roots; common, fine, tubular pores; abrupt, wavy boundary.

D—23 inches +, basalt stones underlain by basalt bedrock.

Profile No. 7—Walla Walla silt loam (S57–Ore–28–2–1 through 5), 0.35 mile due east of Main Street, Wasco, Oregon, 100 feet north of road, SE¼SE¼ sec. 4, T. 1 N., R. 17 E., Sherman County.

A1p—0 to 8 inches, dark grayish-brown (10YR 4.5/2.5) light silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic;

abundant roots; many, fine, interstitial pores; abrupt, wavy boundary.

A1pm—8 to 9½ inches, very dark grayish-brown (10YR 3/2.5, moist) light silt loam; weak, coarse, platy structure breaking to weak, fine, granular; friable, slightly sticky and slightly plastic; abundant roots; common, fine, tubular and interstitial pores; abrupt, wavy boundary.

A12—9½ to 16 inches, dark-brown (10YR 3/3, moist) light silt loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; few, friable, noncalcareous nodules, ⅜ to ⅝ inch in diameter; gradual, wavy boundary.

B21—16 to 24 inches, dark-brown (10YR 3.5/3, moist) light silt loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; common, friable, noncalcareous nodules, ⅜ to ⅝ inch in diameter; gradual, wavy boundary.

B22—24 to 37 inches, pale-brown (10YR 6/3) light silt loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; very few, friable, noncalcareous nodules, ⅜ to ⅝ inch in diameter; abrupt, wavy boundary.

D—37 inches +, basalt bedrock.

Profile No. 8—Walla Walla silt loam (S57–Ore–28–3–1 through 4), ⅛ mile north of section line, 0.1 mile in field from gate at county road, 0.5 mile by county road from U.S. Highway No. 97, SE¼SW¼ sec. 3, T. 1 S., R. 17 E., Sherman County.

A1p—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 2.5/2) when moist; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, interstitial pores; abrupt, smooth boundary.

A1pm—8 to 9½ inches, very dark grayish-brown (10YR 2.5/2, moist) silt loam; very weak, coarse, platy plowpan breaking to weak, fine, granular structure; very friable to friable, slightly sticky and slightly plastic; abundant roots; many, fine and very fine, tubular pores; abrupt, smooth boundary.

B21—9½ to 18 inches, dark-brown (10YR 3/3, moist) silt loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine and fine, tubular pores; clear, smooth boundary.

B22—18 to 30 inches, dark-brown (10YR 3/3, moist) silty loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable but slightly firmer than B21 horizon, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; abrupt, wavy boundary.

D—30 inches +, lime-coated basalt cobbles underlain by basalt bedrock.

Profile No. 9—Walla Walla silt loam (S57–Ore–28–5–1 through 10), 85 feet west of road curve, 15 feet north of section line, SE¼SW¼ sec. 25, T. 1 N., R. 16 E., Sherman County. This profile is described on page 66.

Profile No. 10—Walla Walla silt loam, coarse solum (S57–Ore–33–5–1 through 9), 600 feet north of section line between 12 and 13; 200 feet from farm road along drainageway, SE¼SW¼ sec. 12, T. 1 N., R. 14 E., Wasco County.

Ap—0 to 7 inches, dark grayish-brown (10YR 4.5/2) coarse silt loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure breaking to weak, fine, granular; soft to slightly hard, very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, interstitial pores; abrupt, smooth boundary.

A12—7 to 13 inches, very dark brown (10YR 2/2, moist) coarse silt loam; weak, medium, platy structure breaking to weak, fine, granular; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, interstitial pores; abrupt, smooth boundary.

B21—13 to 20 inches, dark-brown (10YR 3/3, moist) coarse silt loam; weak, coarse, prismatic structure breaking to very weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; clear, smooth boundary.

B22—20 to 31 inches, dark-brown (10YR 4/3, moist) coarse silt loam; weak, coarse, prismatic structure breaking to very weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, fine, tubular pores; gradual, smooth boundary.

C1—31 to 44 inches, dark yellowish-brown (10YR 3/4, moist) coarse silt loam; massive; very friable, slightly sticky and slightly plastic; abundant roots; many, fine, tubular pores; gradual, smooth boundary.

C2—44 to 55 inches, dark yellowish-brown (10YR 3/4, moist) coarse silt loam; massive; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; gradual, smooth boundary.

C3—55 to 82 inches, brown (10YR 5/3) coarse silt loam, dark yellowish brown (10YR 3.5/4) when moist; massive; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; gradual, smooth boundary.

C4—82 to 104 inches, pale-brown (10YR 5.5/3) coarse silt loam, dark yellowish brown (10YR 4/4) when moist; massive; very friable, slightly sticky and slightly plastic; roots plentiful; many, very fine, tubular pores; gradual, smooth boundary.

C5—104 to 140 inches, (horizon not sampled) pale-brown (10YR 5.5/3) coarse silt loam; dark yellowish brown (10YR 4/4) when moist; massive; very friable, slightly sticky and slightly plastic; few to no roots.

Profile No. 11—Walla Walla silt loam, coarse solum, (S57–Ore–28–6–1 through 9), 50 feet west of county road, NW¼NW¼ sec. 22, T. 2 N., R. 17 E., Sherman County. This profile is described on page 69.

Profile No. 12—Walla Walla silt loam, coarse solum (S57–Ore–28–7–1 through 9), 0.4 mile west of section corner, 360 feet north of section line road, SW¼SE¼ sec. 26, T. 2 N., R. 18 E., Sherman County.

A1p—0 to 7 inches, grayish-brown (10YR 4.5/2) silt loam, very dark grayish brown (10YR 2.5/2) when moist; very weak, very thin, platy structure breaking to weak, fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; abundant roots; many, fine pores; abrupt, smooth boundary.

A12—7 to 13 inches, very dark grayish-brown (10YR 3/2, moist) coarse silt loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; clear, smooth boundary.

B21—13 to 19 inches, dark-brown (10YR 3/3, moist) coarse silt loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, slightly sticky and slightly plastic; abundant roots; many, very fine, tubular pores; gradual, smooth boundary.

B22—19 to 30 inches, dark-brown (10YR 4/3, moist) silt loam; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable, moderately sticky and moderately plastic; roots plentiful, many very fine pores; a sprinkling of gray color; clear, smooth boundary.

C1—30 to 46 inches, brown (10YR 5/3) silt loam, dark-brown (10YR 4/3) when moist; very weak, coarse, prismatic structure to massive; hard, friable, moderately sticky, moderately plastic; roots plentiful; many very fine pores; a sprinkling of gray color; clear, smooth boundary.

C2—46 to 60 inches, dark yellowish-brown (10YR 4/4, moist) very fine sandy loam; massive; very friable, slightly sticky and slightly plastic; roots plentiful, many very fine pores; a sprinkling of gray color; few firm nodules, ¼ to ½ inch in diameter; clear, smooth boundary.

C3ca—60 to 66 inches, brown to yellowish-brown (10YR 5/3.5, moist) very fine sandy loam; massive; very friable, slightly sticky and slightly plastic; roots plentiful; many, very fine, tubular pores; few firm nodules, ¼ to ½ inch in diameter; slightly calcareous, lime disseminated; abrupt, smooth boundary.

C4ca—66 to 83 inches, dark-brown (10YR 4/3, moist) very fine sandy loam; massive; firm, slightly sticky and slightly plastic; very few roots; many, very fine, tubular pores; many firm nodules, ¼ to ½ inch in diameter; strongly calcareous, lime in mycelial form; clear, smooth boundary.

C5ca—83 to 91 inches, white (10YR 8/2) very fine sandy loam; light brownish gray (10YR 6/2) when moist; massive to platy structure; extremely hard, very firm, slightly sticky and very slightly plastic; few to no roots; very few, fine, tubular pores; strongly calcareous.

General Nature of the County

This section gives general information about the county. It will be of particular interest to those not familiar with the county.

Physiography and Drainage

Sherman County is entirely on the Columbia Plateau. It is a lava-floored plain that has been uplifted since molten basalt flooded the area. Elevations range from 170 feet along the Columbia River, which forms the northern boundary, to about 3,000 feet in the southern part of the county. The greatest variation in relief, however, is in the northern part. Toward the south, the hills are smooth and slopes are gentle.

Gordon Ridge, which has an elevation of 2,170 feet, is 2 miles north of Moro. North of this ridge, drainage is to the Columbia River. South of the ridge, it is mainly to Barnum and Grass Valley Canyons, then to the John Day River, which forms the eastern boundary of the county. The smallest watershed in the county is off the southwest slopes of this ridge. Streams in this watershed flow to the Deschutes River, which forms the western boundary. More than half of Sherman County and such snowcapped mountains as Mt. Hood, Mt. Adams, Mt. St. Helens, and Mt. Rainier can be seen from Gordon Ridge.

Nigger Ridge, which has an elevation of 2,490 feet, is midway between Moro and Grass Valley. It forms a dividing line between four major soil areas. These areas are described in the section "General Soil Map." Part of this ridge, although only 2 miles from the Deschutes River, drains to the John Day River. Great distances can also be seen from Nigger Ridge.

Gordon Butte, which has an elevation of 1,627 feet, is a dome-shaped knob that rises above a rolling plain in the northwestern part of the county. It is the remnant of a volcanic vent, or a place from which molten lava flowed.

The Columbia River watershed in this county, excluding the John Day River, covers 66,000 acres. In some places narrow sandy terraces parallel the river; in others vertical basalt escarpments rise from 800 to 1,000 feet. Except for a few acres of riverwash, there are no recent alluvial areas. Tributary streams, flowing directly to the river, have rather steep gradients and flow through deep, V-shaped canyons. The Fulton, Spanish Hollow, Scott, and Helms Canyons terminate at the Columbia River.

The Deschutes River, with its main stem and minor tributaries, has a watershed of 147,200 acres in Sherman County. Buck Hollow Creek, along the southwestern county line, is one of its main perennial tributaries. Finnegan and Macken Canyons are the principal drainageways to Buck Hollow Creek. The Jones, Elder Creek, Macks, Sixteen, Harris, and Wingate Canyons terminate at the Deschutes River.

The John Day River has the largest watershed in the county, 318,000 acres. The Barnum, Rosebush, and Hay Canyons are the principal drainageways to Grass Valley Canyon, which terminates at the John Day River. These canyons drain the central part of the county. Other canyons that terminate at this river are the Pine, Jacknife, Ferry, Cottonwood, Emigrant, and Biglow Canyons.

The tributaries of both the Deschutes and John Day Rivers, like those of the Columbia River, flow through deep, V-shaped canyons.

Geology

The soils and land types of Sherman County have formed largely in deposits laid down by wind and water during the Ice Age, or Pleistocene epoch. The loess, which forms an extensive mantle ranging from a few inches to more than 15 feet in thickness, was deposited by wind during a retreat of the continental glaciers and has affected all of the soils in the county to some extent. This loessal deposit is discussed in the subsection "Factors of Soil Formation."

Silt, sand, volcanic ash, and gravel have been moved from the uplands by water, wind, and colluvial action and deposited in the bottoms of the narrow V-shaped canyons. Most of the upper part of this alluvium probably was deposited during the last 11,000 years. Hermiston loam and Sandy alluvial land are developing in these sediments.

The Shutler formation of the Pliocene series occurs south of the Columbia River in a basin formed by a fault scarp (fig. 26). The base of this formation consists of water-rounded gravel. The beds also contain several layers of sand, silt, volcanic ash, and diatomite separated by or coated with lime caliche. Typically, this basalt conglomerate is only 1 to 3 feet thick. These beds outcrop on both walls of the Columbia River canyon and obviously once extended uninterruptedly across the place where the canyon has since been eroded. Erosional remnants indicate that the Shutler formation once covered a much larger area and has since been eroded. Evidence of gravel and caliche occur at elevations of as much as 1,900 feet. To the west, along the Deschutes River, the Shutler formation interfingers with The Dalles formation (*4*). Walla Walla silt loam, coarse solum, and Walla Walla very fine sandy loam are the most extensive soil types underlain by the Shutler formation. If the depth to caliche is 3 feet or more, the soils show little influence of lime except in the several inches immediately above the caliche. If

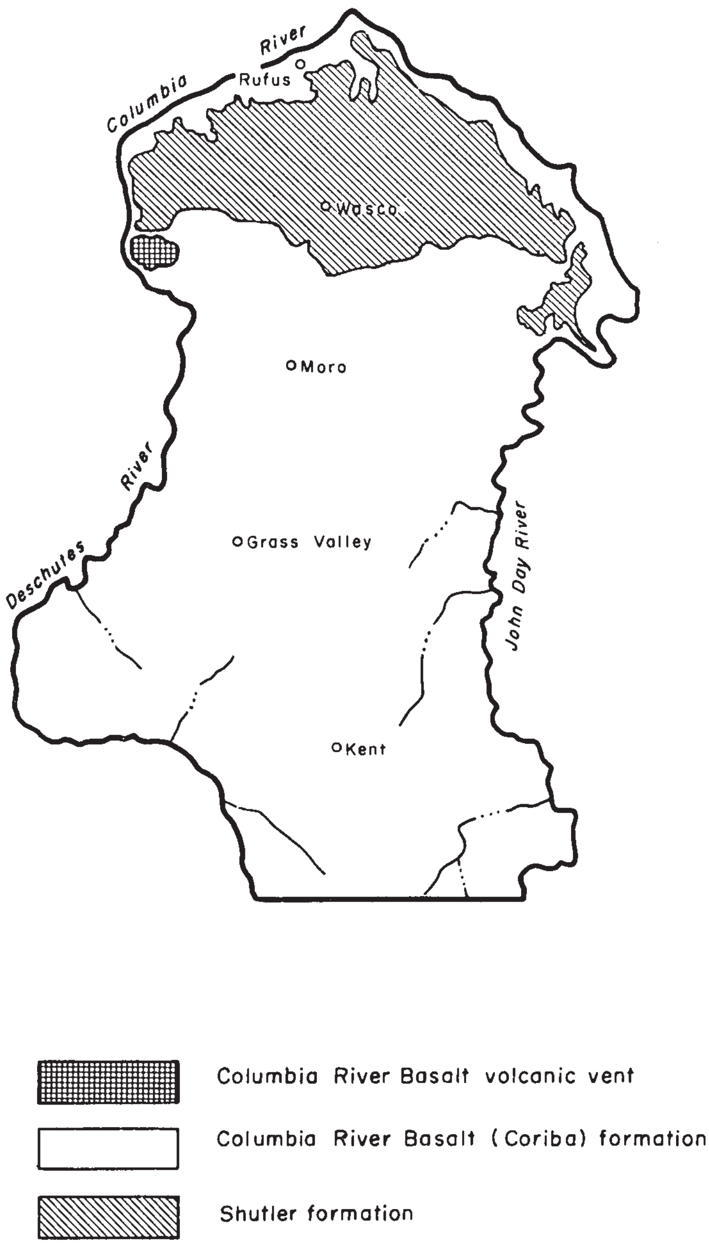

***Figure 26.*—Geological map of Sherman County, Oreg.**

the depth is 3 feet or less, fragments of caliche, basalt and quartz gravel, and calcareous soils are common.

The Columbia River basalt of the Miocene series is the most prominent formation in the county. It is part of a widespread series of basalt flows that extend from Astoria, in the western part of Oregon, east into Idaho and north into Washington. Older formations crop out along the southern edge (*3*). The basalt in this area commonly is more than 2,000 feet thick. It formed when pressures within the earth forced molten lava to the surface through fissures and vents. The lava that poured over the area, flow upon flow, commonly was from 25 to 100 feet thick and extended laterally for miles. The lava rock typically is dense, fine-grained, dark-gray basalt in the massive part of the flows, but it commonly is filled with gas bubbles and is scoriaceous in the upper part. The upper part normally is oxidized and partly weathered so that shades of reds and browns are common (*3*). The reddish and brownish hues of the Bakeoven and Lickskillet soils are the results of this weathering of iron-bearing minerals. The lava flows have some interbeds of old soil, boulders volcanic ash, and cinders.

Uneven uplifting, which resulted in the faulting, folding, and fracturing of the Columbia River basalt formation, has been the dominant influence in the development of the present landform. Tremendous V-shaped canyons and gorges have incised the lava plain, and in many canyons exposed basalt flows are easily observed. A typical flow is characterized by prisms standing vertically side by side as a result of even cooling and contraction. The prisms vary in size from place to place. They may be small, averaging 2 to 3 feet in length and only a few inches in diameter, or they may be many feet in length and a foot or more in diameter. These columnar prisms show a tendency to break at right angles to their length. The breaks at the base are smooth and far apart, but those near the top are conchoidal and close together. Typically, where the flow outcrops, there are large areas of talus or "brickbat" basalt.

Basalt rock is composed largely of andesine and pyroxene. A few phenocrysts of labradorite and, in places, of olivine occur; the feldspars are lath shaped; the pyroxenes are smaller and granular; interstitially is red-colored glass (*4*). In this semiarid climate, basalt rock weathers slowly. The Bakeoven and Lickskillet soils have formed partially from basalt residuum, but loess is their chief parent material. The Kuhl, Starbuck, Nansene, and Wrentham soils have been affected by basalt colluvium, but almost none of the soil material was derived from basalt.

The John Day formation of the late Oligocene and early Miocene series underlies the Columbia River basalt in most places. A few spots, commonly 20 to 100 feet in diameter, are exposed in the county. The formation is typically reddish, greenish, and buff to cream-colored in ascending order (*3*). It is one of the most colorful formations in Oregon. It consists of volcanic ash, tuff beds, some sandstone and agglomerate, and fossil plants and vertebrate remains. No important or extensive soils are forming in these sediments in Sherman County.

Obviously, a strong structural control determines the courses of the John Day and Deschutes Rivers. These streams flow almost parallel. Every large bend in one has its counterpart in the other stream and also in the Columbia River.

Patterned Ground, or Biscuit Scabland

Patterned ground is the general term applied to biscuits or mounds, stone nets, and stone stripes that form distinct patterns on the ground surface, particularly in cold regions.

Patterned ground, locally called biscuit scabland, comprises about 54,000 acres, or more than 10 percent of Sherman County. Theories of the origin of such landforms are so numerous that only one simplified explanation will be given here.

A common kind of pattern that occurs under glacial influence, mainly in perennially frozen areas, indicates that frozen ground cracks at low temperatures and forms rectangular or polygonal patterns. Ice that forms in these nearly vertical cracks may develop into ice wedges. Commonly, these polygonal structures are the result of the contraction of a layer of homogeneous material, either soil or rock, that is perpendicular to the cooling surface. This is well illustrated in the columnar jointing of basalt and in the formation of mud cracks.

The chief climatic significance of the soil patterns as landforms in Sherman County is that frozen ground apparently existed in front of the continental glacier during glacial invasion. A regular pattern of polygonal fractures could form in ground frozen to a uniform depth, as a result of contraction during periods of subfreezing temperature. Ice wedges could form in these if the temperature fluctuated but generally remained below freezing (*5*). Then as the climate became warmer and the front of the continental glacier retreated northward, the ice wedges would begin to melt. The runoff waters could have caused the erosion and modification of the polygons or mounds.

The biscuits are round or elongated, erosion-modified, polygonal mounds that are underlain at a depth of 2 to 3 feet by basalt. The soils in these mounds have weaker profiles than the adjacent soils, but otherwise they are similar to the Condon or Starbuck soils. Frost heaving probably was responsible for mixing various sized fragments of basalt in the soil and for mixing genetically formed horizons. The soils in the mounds are lighter colored than the adjacent soils and are somewhat more rapidly drained. The removal of large amounts of mineral soil in the formation of the mounds is obvious from the scabland that surrounds the mounds.

The soils in the scabland have formed mainly in remnants of material not removed during the thawing of the ice wedges and in material more recently washed from the mounds.

A less striking feature than the mounds are the stone nets, which in places encircle the mounds, and the stone polygons on the scabland. These stone nets and polygons consist of various sized fragments of basalt as much as 2 feet in diameter. Presumably, they resulted from frost heaving along the original ice-wedged cracks (*12*).

Where the slopes are steep, the stone nets and polygons form sorted stripes or rows of rock that vary in length and width. On many of the minor ridges, the mounds occur on the gentle upper slopes; the sorted stone polygons, on the moderately steep intermediate slopes; and the sorted stripes, on the steepest lower slopes. In places, there are sorted stripes that are not associated with nets, polygons, or mounds (*5*).

Climate [5]

Sherman County, because it occurs on the east side of the Cascade Mountains, has predominantly the continental climate of the Intermountain Region. The Columbia Gorge, however, is a natural passageway through the mountains for the normal eastward migration of ocean-conditioned air masses from the Pacific. Much of the time these serve to substantially modify extreme temperatures of both summer and winter. As a result, rarely do the abnormally hot or abnormally cool spells persist for more than a few days at a time. The absolute range in recorded temperature is from 28 degrees below zero to 113 degrees above. During the warm summer months, daytime humidity is low, generally ranging between 35 and 45 percent; thus, the occasional high temperatures do not cause discomfort. The average number of hours of sunshine is greater than in the East and along the Pacific Coast.

Table 12 gives statistical data on the probability that designated temperatures will occur in spring after the dates indicated on the table, and in fall before the dates indicated.

[5] GILBERT L. STERNES, State climatologist, assisted in preparing this section.

690-300—64——7

TABLE 12.—*Probability of stated temperatures in spring and in fall*

Probability	Dates for given probability and temperature at—					
	Moro (elevation, 1,858 feet)			Wasco (elevation, 1,222 feet)		
	24° F. or lower	28° F. or lower	32° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:						
1 year in 10 later than	Apr. 21	May 9	June 1	Apr. 7	May 1	May 21
2 years in 10 later than	Apr. 10	Apr. 30	May 24	Mar. 28	Apr. 23	May 15
3 years in 10 later than	Apr. 1	Apr. 23	May 18	Mar. 22	Apr. 17	May 10
4 years in 10 later than	Mar. 25	Apr. 18	May 13	Mar. 16	Apr. 12	May 6
5 years in 10 later than	Mar. 18	Apr. 13	May 8	Mar. 11	Apr. 7	May 2
6 years in 10 later than	Mar. 12	Apr. 7	May 3	Mar. 5	Apr. 2	Apr. 28
7 years in 10 later than	Mar. 5	Apr. 2	Apr. 28	Feb. 28	Mar. 28	Apr. 24
8 years in 10 later than	Feb. 25	Mar. 26	Apr. 22	Feb. 21	Mar. 22	Apr. 19
9 years in 10 later than	Feb. 13	Mar. 17	Apr. 14	Feb. 12	Mar. 14	Apr. 12
Fall:						
1 year in 10 earlier than	Oct. 15	Oct. 9	Sept. 19	Oct. 17	Oct. 5	Sept. 24
2 years in 10 earlier than	Oct. 25	Oct. 15	Sept. 25	Oct. 25	Oct. 13	Sept. 30
3 years in 10 earlier than	Nov. 1	Oct. 20	Sept. 29	Oct. 31	Oct. 18	Oct. 5
4 years in 10 earlier than	Nov. 7	Oct. 24	Oct. 3	Nov. 5	Oct. 23	Oct. 9
5 years in 10 earlier than	Nov. 12	Oct. 28	Oct. 6	Nov. 9	Oct. 27	Oct. 13
6 years in 10 earlier than	Nov. 18	Nov. 1	Oct. 10	Nov. 14	Nov. 1	Oct. 16
7 years in 10 earlier than	Nov. 24	Nov. 5	Oct. 14	Nov. 19	Nov. 6	Oct. 20
8 years in 10 earlier than	Dec. 1	Nov. 10	Oct. 18	Nov. 24	Nov. 11	Oct. 24
9 years in 10 earlier than	Dec. 10	Nov. 16	Oct. 24	Dec. 2	Nov. 19	Oct. 31

Although the low annual rainfall in the county is characteristic of the Intermountain Region, the fact that about half of it falls during the period November through February reflects the strong influence of marine air masses moving in from the Pacific. Annual totals have varied from 17.17 inches in 1953 at Moro to 4.63 inches in 1939 at Kent. Occasionally, fairly heavy snows result when cold, polar, continental airmasses push down from Canada and mix with the much warmer and relatively moist marine air. In the winter of 1884–85, one such storm resulted in 3 to 5 feet of snow. The average annual snowfall, however, is only about 22 inches, and more than a few inches of snow in a 24-hour period is uncommon. Most precipitation, even in winter, is in the form of rain.

Weather conditions are seldom unfavorable for farmwork, but occasionally rainfall is so meager late in summer and early in fall that many farmers delay planting wheat until late in fall or until spring when moisture conditions are more favorable. During dry years, duststorms are common, especially in the northern part of the county where prevailing westerly winds are strongest. A succession of dry years may cause financial disaster on some farms.

Table 13 is compiled from records of the United States Weather Bureau stations at Wasco in the northern part of the county, at Moro in the central part, and at Kent in the southern part. It gives the monthly, seasonal, and annual temperatures and precipitation at these stations.

Water Supply

Water for drinking and other household uses is obtained chiefly from wells that are dug or drilled to a depth of 20 to 700 feet. On most ranches shallow wells predominate, but deep, drilled wells are becoming more common. Springs and artesian wells furnish water for a few homesteads.

Perennial and intermittent streams are a major source of water for livestock. Water for stock is also supplied by artificial ponds that collect runoff. Some of these ponds are stocked with fish or are used for recreation. Some springs have been developed on canyon slopes, but many ranchers must haul water by truck to dry areas.

Irrigation is not common in the county, primarily because of the limited supply of water on the uplands. Most irrigation is on Sandy alluvial land and on Hermiston loam. These soils occur along the John Day River and other major streams. The Deschutes River, one of the most remarkable rivers in the United States because of its uniform flow and pure water, is not used for irrigation, because there is very little alluvial land adjoining it. Areas along the Columbia River are irrigated with water from the river and springs.

Wildlife [6]

The rolling grasslands and the steep canyons of the Columbia Basin were once the home of the pronghorn antelope. This wilderness animal disappeared as cattlemen settled the area.

Mule deer found a suitable habitat in the county when grain farms replaced many of the livestock farms and the number of such predators as coyotes were reduced. Deer have since become an important game animal.

In 1952 the Oregon State Game Commission permitted

[6] By HAROLD H. WINEGAR, game biologist, Oregon State Game Commission.

TABLE 13.—*Temperature and precipitation at three stations in Sherman County, Oreg.*

Month	Wasco (elevation, 1,222 feet): Temperature [1] Average	Temperature [1] Absolute maximum	Temperature [1] Absolute minimum	Precipitation [2] Average	Precipitation [2] Driest year (1939)	Precipitation [2] Wettest year (1950)	Precipitation [2] Average snowfall
January	30.3	63	−20	1.78	0.72	3.33	9.1
February	35.5	71	−21	1.22	1.01	1.41	4.2
March	43.2	77	14	1.03	.69	1.31	.9
April	50.1	88	18	.66	.05	.57	([7])
May	57.1	100	26	.73	.28	.08	0
June	63.1	104	34	.83	.31	1.60	0
July	70.6	113	40	.19	.10	.02	0
August	69.4	105	37	.19	.16	.06	0
September	62.5	101	21	.46	.07	.09	0
October	51.8	87	11	1.15	.21	3.89	([7])
November	39.6	76	6	1.62	.06	2.07	1.7
December	34.6	65	−28	1.86	1.75	2.73	3.9
Year	50.7	113	−28	11.72	5.41	17.16	19.8

Month	Moro (elevation, 1,858 feet): Temperature [3] Average	Temperature [3] Absolute maximum	Temperature [3] Absolute minimum	Precipitation [4] Average	Precipitation [4] Driest year (1939)	Precipitation [4] Wettest year (1953)	Precipitation [4] Average snowfall
January	30.1	65	−22	1.75	0.72	4.89	9.7
February	34.6	68	−23	1.23	1.06	1.30	4.7
March	41.6	77	7	.98	.93	.74	1.4
April	48.4	89	19	.78	.03	1.29	([7])
May	55.6	96	20	.76	.23	1.78	0
June	61.3	102	31	.90	.50	.87	0
July	68.7	111	34	.18	.26	0	0
August	67.7	102	35	.16	([7])	.88	0
September	61.3	97	21	.49	.37	.11	.1
October	50.8	85	8	1.15	.21	.39	0
November	38.9	70	−10	1.71	.03	2.80	1.2
December	33.6	63	−20	1.74	2.09	2.12	5.3
Year	49.4	111	−23	11.83	6.43	17.17	22.4

Month	Kent (elevation, 2,707 feet): Temperature [5] Average	Temperature [5] Absolute maximum	Temperature [5] Absolute minimum	Precipitation [6] Average	Precipitation [6] Driest year (1939)	Precipitation [6] Wettest year (1948)	Precipitation [6] Average snowfall
January	29.6	60	−17	1.22	0.21	1.36	8.0
February	33.5	65	−19	.99	.57	1.39	5.8
March	39.6	76	11	.93	.76	1.00	2.4
April	46.3	89	18	.84	.13	1.09	.7
May	53.6	93	21	1.07	.17	2.73	0
June	59.8	99	32	1.11	.52	2.28	0
July	67.7	108	37	.23	.25	1.05	0
August	66.6	101	37	.26	([7])	.48	0
September	60.3	97	21	.57	.51	1.24	.2
October	50.4	89	8	.94	.14	.20	.3
November	38.5	74	5	1.33	.02	1.50	1.2
December	32.8	65	−8	1.34	1.35	2.12	4.9
Year	48.2	108	−19	10.83	4.63	16.44	23.5

[1] Average temperature based on a 22-year record, through 1952; highest and lowest temperatures based on a 40-year record, through 1952.

[2] Average precipitation based on a 25-year record, through 1955; wettest and driest years based on a 45-year record, through 1952. Average snowfall based on a 22-year record, through 1952.

[3] Average temperature based on a 25-year record, through 1955; highest and lowest temperatures based on a 43-year record, through 1958.

[4] Average precipitation based on a 25-year record, through 1955; wettest and driest years based on a 49-year record, through 1958. Average snowfall based on a 22-year record, through 1952.

[5] Average temperature based on a 25-year record, through 1955; highest and lowest temperatures based on a 30-year record, through 1952.

[6] Average precipitation based on a 25-year record, through 1955; wettest and driest years based on a 30-year record, through 1952. Average snowfall based on a 22-year record, through 1952.

[7] Trace.

hunting of buck deer in the county during the general deer season. Table 14 shows the kill figures and hunter success through the 1958 hunting season.

TABLE 14.—*Deer killed and hunter success for stated years*

Year	Number of hunters	Kill			Percentage of hunters successful	County area	Deer harvested
		Bucks	Antlerless	Total			
						Sq. mi.	*No. per sq. mi.*
1952	342	160	(1)	160	46. 7	830	0. 2
1953	421	179	56	235	55. 9	830	. 3
1954	592	227	98	325	54. 9	830	. 4
1955	504	237	(1)	237	47. 0	830	. 3
1956	705	235	(1)	235	33. 3	830	. 3
1957	1, 008	363	202	565	56. 0	830	. 7
1958	806	343	105	448	55. 6	830	. 5

[1] No open season.

The kind of range forage in Sherman County normally is not considered good winter feed for deer. Bitterbrush is almost nonexistent. Other palatable shrubs, such as big sagebrush and currant, are not prominent even in depleted areas. Stiff sagebrush does provide valuable browse on shallow ridgetops. The narrow canyon bottoms provide such winter forage as sumac, serviceberry, currant, chokecherry, mockorange, alder, and willow, but these areas are small.

In spite of this apparent lack of shrubs normally considered to be the major source of winter feed for deer, the legal reported kill in the county has steadily increased. It was nearly three times greater in 1958 than in 1952. This indicates a rising population of mule deer and satisfactory forage.

Because of its high reproductive capacity, the mule deer will remain compatible with other land uses if harvested wisely for game.

The sharp-tailed grouse, locally called prairie chicken, disappeared from the county as grain farming increased. A small population of plumed quail, which are closely related to the mountain quail of western Oregon, live in a few isolated canyons and probably are the only remaining native game bird on the uplands. The Chinese ring-necked pheasant, Mongolian pheasant, valley quail, Hungarian partridge, and chukar partridge have been introduced in the county and are providing good recreation. The mourning dove also provides some hunting.

The canyons of the John Day and Deschutes Rivers and the steep, rocky canyons running into them constitute a large part of the nearly 230,000 acres not used for crops in the county. These deep, rocky canyons are excellent habitat for the chukar partridge and provide fair habitat for plumed quail, Hungarian partridge, valley quail, and deer. Pheasants, however, prefer areas adjacent to cropland, if cover and water are available.

In the grainfields, there are hundreds of miles of narrow draws that are inaccessible to large farm machinery. With the cooperation of the farmers, the State Game Commission is establishing cover for upland game in these and in other inaccessible areas by planting trees and shrubs and by fencing to exclude livestock. Water is supplied by means of cisterns to catch rain and snow.

Some 40 species of migratory waterfowl and shorebirds can be seen at some time during the year on the waters and in the fields surrounding and within the county. Of these, the Canada goose, cackling goose, and mallard, baldpate, and pintail ducks are most important as game.

Most of the song and insectivorous birds of eastern Oregon can be seen in the county at some time during the year. Those most common are the English sparrow, dusky horned lark, western meadowlark, Brewer's blackbird, American magpie, and American raven. The turkey vulture, or buzzard, is a common summer resident.

Commonly seen among the owls, hawks, and eagles are the goshawk, Cooper's hawk, sharp-shinned hawk, Western red-tailed hawk, Swainson's hawk, American rough-legged hawk, marsh hawk, sparrow hawk, golden eagle, MacFarlane's screech owl, great horned owl, long-eared owl, and short-eared owl.

Some of the more common smaller mammals found in the county are the coyote, bobcat, black-tailed jackrabbit, white-tailed jackrabbit, Oregon cottontail, porcupine, raccoon, marmot, two species of ground squirrel, meadow mouse, white-footed mouse, shrew, pocket gopher, striped skunk, spotted skunk, badger, beaver, mink, weasel, and muskrat.

The rivers and streams bordering the county provide good fishing for steelhead trout, rainbow trout, brown trout, Chinook salmon, bullhead, channel catfish, sturgeon, and a variety of nongame fish. Many man-made farm ponds are highly productive fisheries.

The conservation of wildlife in Sherman County is in balance with that of the soil resources, and wise use will insure continuation of the balance that now prevails.

History and Early Settlement [7]

The first white man to make an appraisal of what is now Sherman County was Maj. Enoch Steen. Major Steen left The Dalles on May 19, 1860, to explore southeastern Oregon at the request of General William Harney, who wanted to develop a road to aid transportation to the Northwest.

The first settlement in the county was in 1860, when William Graham crossed to the east bank of the Deschutes River to tend the bridge and to establish a hotel. This was almost 20 years after men had been traveling across the county in covered wagons on the last leg of their long trip from the East, and 10 years after stagelines had crossed the county on the trip from The Dalles to Umatilla Landing, where pack outfits and freighters' wagons left for the Idaho mines.

Stockmen gradually moved into the area during the 1860's and 1870's. Most of these men raised horses to sell to the settlers in Willamette Valley. Cattle had little value until the intercontinental railroads crossed the county. Then there were great cattle drives to take the famed Oregon cattle into Wyoming to the railheads.

By 1880, when a railroad was being built along the Columbia River, men from the middle border, emigrants from Germany, England, Portugal, Sweden, and Ireland,

[7] By GILES L. FRENCH, editor and publisher, Sherman County Journal.

and southerners, unhappy about reconstruction, came in by stage and by foot and set stakes for their homesteads. They settled the area in 5 years. It was excellent stock country and proved to be excellent farming country. There was no erosion of the soil until the white man came and drove his cattle up and down the trails.

Organization, Population, and Community Facilities

County government was started in 1889 when Sherman County was separated from Wasco County. Except for State highways, the roads are constructed and maintained by the county government, which is also responsible for the general government, the collection of taxes, and the keeping of the peace. There are five elementary school districts and one high school district.

Towns have their own government. In early times, competition between the towns for the farmers' business was so even that no one town attained a commanding position, and all have remained small.

In 1900, when settlement of the county was completed, the population was 3,477. It reached a peak of 4,242 in 1910. By 1940 it had decreased to 2,321, and by 1950 to 2,271. The census of 1960 showed the population to be 2,446.

There are eight churches in the county and two granges. In addition, there are clubs, civic groups, and farmers' organizations to suit the needs and wishes of the inhabitants.

Transportation and Markets

A branch of the Union Pacific Railroad extends from Biggs, on the main line along the Columbia River, to Kent, near the southern border. Nearly all of the grain is shipped by rail. In recent years, however, there has been more trucking of wheat. Although bargelines ply the Columbia River, there is no port in Sherman County. Livestock and grain are trucked to Portland, the principal market. There are over 600 miles of county roads. U.S. Highway No. 97 extends from north to south. U.S. Highway No. 30 extends from east to west along the Columbia River. Paved roads now connect Grass Valley and Sherar, in Wasco County.

Wheat, barley, and other cereal grains are marketed chiefly through cooperatives. In recent years, a few elevators and grain bins have been erected on farms, and marketing is done on an individual basis.

Agriculture [8]

Agriculture is the major enterprise in Sherman County. Wheat is the main crop and the principal source of income. Raising of beef cattle is second as a source of income. The native range provides good grazing in spring and early in summer, and fields can be grazed after crops are harvested. Modern methods of farming, which are used throughout the county, include the use of improved varieties of wheat, the use of large-scale power equipment, the application of chemical fertilizers, the use of chemicals for weed control, and the rigid selection of stock for breeding purposes. Unless otherwise stated, the statistics given in this section are from the U.S. Census of Agriculture.

[8] By THOMAS W. THOMPSON, county extension agent.

Crops

Winter wheat is the most important crop in the county. For about 40 years, dryland hay was the second most important crop. However, in the past few years barley has gained in importance because the acreage taken out of wheat under the wheat acreage allotment program has been used for growing barley. Oats is grown mainly for feed; rye is grown on the small acreage not suited to barley. Table 15 shows the acreage in principal crops for stated years, based on estimates of the Oregon State University Extension Service.

TABLE 15.—*Acreages of principal crops for stated years*

Crop	1939	1949	1959
Small grain	98, 650	126, 600	139, 200
Wheat harvested	92, 500	122, 000	92, 700
Barley harvested	4, 800	4, 000	43, 000
Oats harvested	1, 300	600	2, 000
Rye harvested	50	(1)	500
Grain grown together and harvested	(1)	(1)	1, 000
Hay crops	8, 700	4, 965	6, 000
Alfalfa and mixtures	100	340	800
Grain hay	8, 500	4, 300	5, 000
Meadow and grass hay	100	325	200

[1] None harvested.

In the past 10 years, grain yields in the county have been significantly higher than in any previous period. Many factors contribute to this increase, including the use of improved varieties, chemical control of weeds, timeliness of operations, adequate farm power (fig. 27), above-average rainfall, and the use of nitrogen fertilizer. Yields of barley averaged nearly three-quarters of a ton per acre in this period, and yields of oats averaged slightly less.

The average yield of wheat, based on a 10-year record through 1959, is 32.75 bushels per acre. The lowest yields

Figure 27.—**Bulk handling of winter wheat. This operation is commonly done while self-propelled combine is moving.**

recorded were in 1889 and 1899. The highest were in 1958 and 1959. The first year that the annual yield of wheat averaged more than 30 bushels was in 1941. Estimated yields of wheat in bushels per acre are given in the following list. The yields for 1889 to 1924 are from a publication of the Oregon Agricultural Experiment Station, "An Economic Study of Dry Land Wheat Farming in the Columbia Basin, Oregon," dated February 1937. Those from 1926 to 1959 are based on annual estimates made by the Oregon Crop and Livestock Reporting Service, prepared by the Oregon State University Extension Service specialists in agricultural economics information.

Year	*Bu. per acre*	*Year*	*Bu. per acre*	*Year*	*Bu. per acre*
1889	4. 6	1932	16. 9	1947	21. 6
1899	11. 5	1933	17. 4	1948	32. 5
1909	12. 5	1934	13. 9	1949	23. 7
1919	18. 4	1935	15. 1	1950	24. 6
1920	20. 6	1936	18. 3	1951	30. 2
1921	26. 5	1937	17. 5	1952	30. 9
1922	23. 9	1938	19. 8	1953	34. 1
1923	29. 4	1939	20. 6	1954	34. 0
1924	13. 6	1940	16. 4	1955	29. 9
1926	19. 6	1941	30. 6	1956	32. 6
1927	27. 1	1942	27. 8	1957	35. 6
1928	22. 7	1943	26. 0	1958	37. 6
1929	14. 1	1944	25. 1	1959	38. 0
1930	17. 9	1945	21. 7		
1931	13. 2	1946	26. 6		

Since 1939 there has been a decrease in the acreage in dryland grain hay because of the increase in the use of power equipment. The acreage in alfalfa and in alfalfa-grass mixtures for hay or pasture has increased but is still of minor importance.

Table 16 shows the trend in irrigation of certain crops in the county. Irrigation of forage crops is undertaken on the flat bottom lands adjacent to streams or in areas where wells or irrigation reservoirs have been constructed. In these areas the soils are sandy to loamy. Additional irrigation can be undertaken where deep wells are located or where the sandy alluvial soils along the John Day River are leveled.

Alfalfa is the principal legume grown for irrigated hay. Alfalfa or combinations of alfalfa and improved dryland grasses are grown for hay and pasture on cultivated soils under a crop rotation program. Irrigated pastures commonly are straight grass, alta fescue or orchardgrass, or a combination of these grasses.

TABLE 16.—*Trend in irrigated acreages in stated years*

	1939	1949	1954	1959
Irrigated land in farms	[1]	[2] 322	602	1, 505
Irrigated cropland harvested	194	206	358	665
Orchards	118	78	95	45
Irrigated pasture	[3]	6	244	840

[1] Not reported.
[2] Includes 110 acres irrigated cropland not harvested and not pastured.
[3] Less than three farms reporting.

For many years the sandy soils adjacent to the Columbia River have been used for the production of fruit. Although springs, wells, and the river provide plenty of water for irrigation, the acreage in fruit is small. During the past 10 years, because of backwater from the Dalles Dam and the relocation of railroads and highways, the number of acres in fruit trees has decreased (see table 16).

Rotations and Fertilization

A 2-year rotation of crop and summer fallow is the farming system commonly used in the county. The soil is tilled in March or April and kept clear of weeds until fall. Winter grain is seeded in summer fallow during September and October and harvested during the following July and August. After harvest, the stubble is left standing until the soil is tilled in March or April of the following year.

This summer-fallow system of farming is needed on most soils in order to allow a 2-year accumulation of moisture and of soil nitrates and other plant nutrients. Because of the loss of organic matter and the above-average rainfall, nitrogen fertilizer has been used on the deeper soils in the county.

Prior to 1940, results at the Sherman Branch Experiment Station showed a decrease in yields if nitrogen fertilizer was used. By 1950 the results showed an increase, probably because of the decline in the content of organic matter and the above-average rainfall. Present sources of nitrogen fertilizer are aqua and anhydrous ammonia and, to a lesser extent, ammonium nitrate and ammonium sulfate (*8*).

The results of farm demonstrations and of experiments at the Sherman Branch Experiment Station indicate that tilth is improved and yields increased if grain follows a 4-year grass-legume rotation. A grass or grass-legume rotation is needed on most cultivated soils to maintain the organic-matter content and to provide for a permanent type of agriculture. Such rotations will also permit an increase in the number of livestock to utilize the grain grown for feed and the excess crop residues.

Livestock and Livestock Products

Raising beef cattle is the most important livestock enterprise in the county. The number of sheep has been reduced because of the lack of sheepherders. The development of power equipment has greatly reduced the need for horses or mules. Grain hay, formerly grown as feed for horses, is now fed to beef cattle.

Cattle utilize nearly 200,000 acres of the native rangeland in addition to stubble fields, improved pastures, and scabland. Calving generally is in spring. Calves are sold as weaners in fall or are roughed throughout the winter and sold as yearlings. There are no large-scale feedlots. A few operators feed a small number of yearlings to slaughter weight and grade.

The number of milk cows has steadily decreased. There is no graded dairy in the county. All milk produced is consumed on the farms. A small amount of cream is sold.

The use of horses has shifted from draft horses to pleasure or stock horses. By 1960 there were only half a dozen farm teams in the county.

The number of swine changes from year to year in relation to home needs and to the changes in the price of grain. By 1960 the number was increasing and probably will continue to increase if grain prices decline. There are only a few flocks of sheep in the county.

Table 17 shows the number of livestock on farms for stated years, according to estimates of the Oregon State University Extension Service.

TABLE 17.—*Number of livestock on farms for stated years*

Livestock	1939	1949	1959
Horses and mules	2, 430	700	680
Cattle	8, 600	11, 400	14, 000
Beef cows, under 2 years	2, 300	6, 100	7, 100
Milk cows	1, 150	500	500
All other cattle	5, 150	4, 800	6, 400
Sheep	12, 800	1, 000	1, 500
Swine	4, 000	2, 500	1, 200
Chickens	22, 000	10, 000	10, 000

Major Sources of Income and Major Expenditures

Since World War II, 80 to 90 percent of the income in Sherman County has been derived from the sale of cash crops. Wheat is the principal source of income. More than $10 million of new wealth, in terms of farm products, was produced in 1952. The acreage allotments program, initiated in 1953, reduced the production of wheat.

During the 1930's and the early part of the 1940's, income from livestock was considerably higher than in recent years. During these years the income from farm products amounted to $2 million to $4 million. Cash crops accounted for 65 to 70 percent of the income, and livestock for the rest.

According to the 1959 census, 74 of the 218 commercial farms sold $40,000 or more of farm produce; 95 farms sold between $20,000 and $39,999 of farm produce; 30 farms sold between $10,000 and $19,999; and the rest, less than $10,000.

The operating expenses of commercial grain farms are high. Large-scale expensive equipment is required, and in addition, there are large expenditures for hired labor, gasoline, petroleum fuel, fertilizer, and livestock feed. The 1959 census shows that hired labor is the highest single farm expense.

Type and Size of Farms

There were 247 farms in the county in 1959. These farms occupied 521,700 acres, or 98.2 percent of the acreage in the county. Improved cultivated land accounted for 299,882 acres, or 57.5 percent of the land in farms. Land not in farms includes towns, rail and highway rights-of-way, and public land. The largest part of the acreage in public land is the Taylor grazing allotments, which are leased to cattle ranchers under the direction of the Department of Interior.

Table 18 shows the number of farms in the county for stated years, and the acreage in farms. In 1959, of the 247 farms in the county, 202 were cash-grain farms; 15 were livestock farms; 1 was a general farm; and 29 were unclassified.

Farms have increased in size from an average of 1,179.4 acres in 1930 to 2,112.1 acres in 1959. This increase has been mainly the result of mechanization. Improved land on farms in 1959 averaged about 1,200 acres per farm. Under the summer-fallow system of farming practiced in the county, half of the acreage is in crops each year. According to the 1959 census, about 70 percent of the farms were 1,000 acres or larger in size, and 21 percent were between 500 and 1,000 acres. The larger farms can be more efficiently operated with modern equipment.

Farm Tenancy

According to the 1959 census, owners operated 21.5 percent of the farms in the county; part owners, 42.9 percent; managers, 1.2 percent; and tenants, 34.4 percent. Much of the land in farms is owned by retired farmers or by persons living outside of the county.

All tenants operate on a crop-share basis. The agreement generally is that a third of the crop goes to the owner for rent. The owner maintains the permanent buildings and fences, but the tenant supplies the labor for repairs. The tenant provides all of the labor, equipment, and seed to operate the farm. He also provides the chemicals needed to control annual weeds. The cost of fertilizer and the cost of chemicals to control perennial weeds generally are shared. Taxes usually are paid by the landowner. Tenant farms on which livestock is raised are operated in a different manner. On small farms, the operator may own some stock that is not shared. On larger farms, where more pasture is available, the owner either receives a share of the livestock produced or is paid in cash on a per-acre rental.

TABLE 18.—*Number of farms and acreage in farms for stated years*

Year	Land in farms		Number of farms	Average size	Improved land in farms		
	Acres	*Percent*		*Acres*	*Percent*	*Percent*	*Acres per farm*
1930	435, 214	[1] 81. 3	369	1, 179. 4	286, 579	65. 8	776. 6
1940	462, 375	[2] 87. 0	343	1, 348. 0	294, 452	63. 7	858. 5
1950	492, 293	[2] 92. 7	275	1, 790. 2	292, 948	59. 5	1, 065. 3
1954	495, 225	[2] 93. 2	265	1, 868. 8	290, 335	58. 6	1, 095. 6
1959	521, 700	[3] 98. 2	247	2, 112. 1	299, 882	57. 5	1, 214. 1

[1] Based on the acreage shown for the county in the Census of Agriculture for 1930.
[2] Based on the acreage shown for the county in the Census of Agriculture for 1940, 1950, and 1954.
[3] Based on the acreage shown for the county in the Census of Agriculture for 1959.

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Glossary

Aggregate (soil structure). Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is reduced.

Alkaline soil. Generally, a soil that is alkaline throughout most or all of the part of it occupied by plant roots; although the term is commonly applied to only a specific layer or horizon of a soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

Alluvium. Fine material, such as sand, silt, or clay, that has been deposited on land by streams.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. An excavation produced by wind action in loose soil, usually sand.

Bottom land. Nearly level land occupying the bottom of the valley of a present stream and subject to flooding unless protected artificially.

Calcareous. Of a soil, containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

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.

Clod, soil. A mass of soil produced by disturbances, such as plowing or digging, in contrast to a ped, which is a natural soil aggregate; generally a clod slakes easily with repeated wetting and drying.

Colluvium. Soil material or rock fragments moved by soil creep, slides, and local wash and deposited near the base of rather steep slopes.

Consistence. The combination of properties of soil material that determines its resistance to crushing and its ability to be molded or changed in shape. Consistence depends mainly on the forces of attraction between soil particles. Consistence is described by such words as *loose, friable, firm, soft, plastic,* and *sticky*.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions; strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Creep, soil. The downward movement of masses of soil and soil material, primarily through the action of gravity. The movement is generally slow and irregular. It occurs most commonly when the lower part of the soil is nearly saturated with water, and it may be facilitated by alternate freezing and thawing.

Cropland. Land regularly or periodically farmed for the production of crops; does not include land producing native forage or permanent range seedings.

Crop year. The year in which a crop is to be harvested; in contrast to the fallow year, during which no crop is grown and the soil accumulates moisture for the crop year.

Cross-slope farming. Plowing, cultivating, planting, and harvesting across the general slope, but not on the contour as in contour farming.

Crosswind farming. Plowing, cultivating, and planting crosswise to the general direction of the prevailing winds, without strict adherence to contour.

Diversion. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage, soil. (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation. For example, in well-drained soils, the water is removed readily, but not rapidly; in poorly drained soils, the root zone is waterlogged for long periods and the roots of ordinary crop plants cannot get enough oxygen; in excessively drained soils, the water is removed so completely that most crop plants wither from lack of water.

Dryfarming. Production of crops that require some tillage in a subhumid or semiarid region, without irrigation. Usually involves use of periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. The soil ordinarily is tilled for at least one growing season to control weeds and to aid in the decomposition of plant residues.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition (or tilth) of the soil, are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Field stripcropping. Growing crops in strips, or bands, across the general slope, but not on the contour, so that strips of grain crops are alternated with strips of fallow or with strips of grass and legumes.

Ground water (geology). Water that fills all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Horizon, soil. A layer of soil, approximately parallel to the surface, with characteristics produced by soil-forming processes. The relative positions of the several soil horizons in the soil profile and their nomenclature are given below.

- A0 Organic debris, partly decomposed or matted.
- A1 A dark-colored horizon having a fairly high content of organic matter mixed with mineral matter.
- A2 A light-colored horizon, often representing the zone of maximum leaching where podzolized; absent in wet, dark-colored soils.
- A3 Transitional to B horizon but more like A than B; sometimes absent.
- B1 Transitional to B horizon but more like B than A; sometimes absent.
- B2 A usually darker colored horizon, which often represents the zone of maximum illuviation where podzolized.
- B3 Transitional to C horizon.
- C Slightly weathered parent material; absent in some soils.
- D Underlying substratum.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Leaching. The removal of soluble materials from soils or other material by percolating water.

Moisture-supplying capacity. The ability of the soil to hold water that will not drain away but that can be taken up by plant roots.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue.

Pan. A layer in a soil that is firmly compacted or very rich in clay. Frequently the word "pan" is combined with other words that more explicitly indicate the nature of the layers, for example, *hardpan, fragipan, claypan,* and *traffic pan.*

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. (See also Horizon, soil.)

Reaction, soil. The degree of acidity or alkalinity of the soil, expressed in pH values or in words, as follows:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Runoff. The removal of water by flow over the surface of the soil. The amount and rapidity of surface runoff are affected by the texture, structure, and porosity of the surface layer, by the vegetative covering, by the prevailing climate, and by the slope. The rate of surface runoff is expressed as follows: *Ponded, very slow, slow, medium, rapid,* and *very rapid.*

Sand. (1) Individual rock or mineral fragments having diameters ranging from 0.05 millimeter to 2.0 millimeters. Sand grains consist chiefly of quartz, but they may be of any mineral composition. (2) As a soil textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. (1) Individual mineral particles of soil that range in diameter from 0.002 millimeter to 0.05 millimeter. (2) As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope, soil. The incline of the surface of a soil. It is usually expressed in percentage of slope, which equals the number of feet of fall per 100 feet of horizontal distance. The slope classes used in this report are:

	Percent		*Percent*
Nearly level	0 to 2	Steep	20 to 35
Gently sloping	2 to 7	Very steep	35 to 70
Moderately steep	7 to 20		

Soil depth. The depth to which the roots of common crops penetrate; the depth to the underlying bedrock or to other restrictive layer. The depth classes used in this report are:

	Inches		*Inches*
Very shallow	0 to 12	Deep	38 to 60
Shallow	12 to 18	Very deep	More than 60 inches
Moderately deep	18 to 38		

Structure, soil. The aggregation of primary soil particles into compound particles, or into clusters of primary particles, which are separated from adjoining aggregates by surfaces of weakness. Soil structure is classified according to grade, class, and type.

Grade. Distinctness of aggregation. It expresses the differential between cohesion within aggregates and adhesion between aggregates. Terms: *Structureless* (*single grain* or *massive*), *weak, moderate,* and *strong.*

Class. Size of aggregates. Terms: *Very fine* or *very thin, fine* or *thin, medium, coarse* or *thick,* and *very coarse* or *very thick.*

Type. Shape and arrangement of individual natural soil aggregates. Terms: *Platy, prismatic, columnar, blocky, subangular blocky, granular,* and *crumb.* (Example of soil-structure grade, class, and type: Moderate, coarse, subangular blocky.)

Subsoil. Technically, the B horizon of a soil with a distinct profile; commonly, that part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil.

Surface soil. Technically, the A horizon; commonly, the plow layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or sea. Stream terraces are frequently called *second bottoms,* as contrasted to *flood plains,* and are seldom subject to overflow. Marine terraces were deposited by the sea and generally are wide. The Sagemoor soil occurs on an old terrace.

Texture, soil. The relative proportions of the various size groups of individual soil grains in a mass of soil; specifically, the proportions of sand, silt, and clay. (See also Sand, Silt, and Clay.)

Tilth, soil. The physical properties of the soil that affect the ease with which it can be cultivated or its suitability for crops; implies the presence or absence of favorable soil structure.

Transpiration. The discharge of water vapor into the atmosphere from the leaves and stems of living plants.

Upland (geology). Land consisting of material unworked by water in recent geologic time and generally at a higher elevation than the alluvial plain or stream terrace; land above the lowlands along rivers or between hills.

Vesicle. A small, spherical cavity in volcanic rock, produced by bubbles of air or gas in the molten rock.

Water table. The upper surface of free ground water in a zone of saturation, except when separated from an underlying body of ground water by unsaturated material.

Wind and water stripcropping. Growing crops in strips, taking into consideration both the direction of the wind and the contour of the slope; strips of grain crops are alternated with strips of fallow or strips of grass and legumes.

Wind stripcropping. Growing crops in strips that are crosswise to the general direction of the prevailing wind, without strict adherence to the contour of the slope.

Workability. The ease of performing tillage, harvesting, and other farming operations on the soil. The terms used in this report are: *Very good*, *good*, *fair*, *poor*, or *very poor*.

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