foreword

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

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

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

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

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Location of Grant County in Washington.

Soil survey of
Grant County, Washington

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GRANT COUNTY is in the central part of Washington. It has a total area of 1,707,870 acres, or about 2,669 square miles. Ephrata is the county seat. The population of the county in 1978 was about 48,000.

The Columbia River flows in a deep valley along the southwestern boundary of the county. The northern part of the county is characterized by loess mantled hills that have been dissected by the Channeled Scablands. The southern part in general is a smooth, southward-sloping plain that is deeply dissected and is interrupted by the Saddle Mountains and Frenchman Hills. Babcock Ridge and Beezly Hills border the northern part of the plain.

Elevation ranges from 380 feet along the Columbia River in the southern part of the county to 2,882 feet on top of Monument Hill.

Soil scientists determined that there are about 62 different kinds of soil in Grant County. The soils have a wide range in texture, natural drainage, and other characteristics. Soil blowing and water erosion are the major soil-related problems in the southern part of the county, and water erosion is the major soil-related problem in the northern part. Control of erosion minimizes the pollution of streams by sediment and improves the quality of the water available for municipal use, for recreation, and for fish and wildlife.

Agriculture is the main economic enterprise in the county. About 19 percent of the total area is irrigated cropland, about 18 percent is nonirrigated cropland, and about 63 percent is rangeland. The main irrigated crops are winter wheat, alfalfa hay, potatoes, corn, and beans. The main nonirrigated crop is winter wheat.

Two older reconnaissance-type soil surveys covering parts of the county have been previously published (5, 14). The present survey updates the earlier surveys, provides data on areas not covered by them, and gives additional information and maps that show the soils in greater detail.

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

climate

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

The climate in Grant County is influenced to a great extent by the Cascade Range and the Rocky Mountains. The Rocky Mountains shield the county from the more severe winter storms moving southward across Canada, while the Cascade Range forms a barrier to the easterly movement of moist air from over the ocean; however, some of the air from each of these sources reaches the county.

In Grant County, summers are warm or hot. Precipitation in summer falls mainly as showers but some thunderstorms occur. In winter the ground is covered with snow much of the time. Chinook winds, which blow downslope and are warm and dry, often melt and evaporate the snow. Because of cold air drainage, precipitation occurs in the mountains in adjacent counties throughout the year, and a deep snowpack accumulates in winter. Snowmelt usually supplies

irrigation water for intensive farming in parts of the Columbia Basin.

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

In winter the average temperatures at Quincy and Wilbur are 30 and 29 degrees F, respectively. The average daily minimum temperature is 21 degrees at Quincy and 22 degrees at Wilbur. The lowest temperature, which occurred at Wilbur on January 26, 1957, is -23 degrees. In summer the average temperature is 69 degrees at Quincy and 65 degrees at Wilbur. The average daily maximum temperature is about 83 degrees. The highest recorded temperature, which occurred at Quincy on June 17, 1961, and at Wilbur on August 4, 1961, is 106 degrees.

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

The total annual precipitation is 8 inches at Quincy and 12 inches at Wilbur. Of this, 35 percent usually falls in April through September, which includes the growing season for most crops. The heaviest 1-day rainfall during the period of record was 1.4 inches at Quincy on October 27, 1956. Thunderstorms occur on about 7 days each year, and most occur in summer.

Average seasonal snowfall is 22 inches at Quincy and 28 inches at Wilbur. The greatest snow depth at any one time during the period of record was 24 inches at both Quincy and Wilbur. On the average, 11 to 14 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The sun shines 75 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 8 miles per hour, in spring.

how this survey was made

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

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

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

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

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

general soil map units

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

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

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

The general soil map at the back of this survey does not join, in all instances, with the general soil maps for adjacent survey areas. Differences in the maps have resulted from differences in the occurrence of soil patterns, differences in the publication scale of the maps, and the recent advances in classification.

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

soils on terraces, active dunes, and alluvial fans

This group consists of 10 map units. It makes up about 57 percent of the survey area. The soils in this group are nearly level to steep. The native vegetation is mainly grasses and shrubs.

The soils in this group are very deep, moderately deep, shallow, and very shallow and are well drained to excessively drained. They formed in glacial outwash, lacustrine deposits, eolian sand, sand derived from mixed sources, loess, and alluvium.

This group is used for irrigated crops, rangeland, wildlife habitat, and nonirrigated crops.

1. Kennewick-Warden-Sagemoor

Very deep, well drained, nearly level to moderately steep soils; on terraces

This map unit is in the southern part of the survey area. Slope is 0 to 25 percent. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 140 to 210 days.

This unit makes up about 11 percent of the survey area. It is about 40 percent Kennewick soils, 20 percent Warden soils, and 10 percent Sagemoor soils. The remaining 30 percent is components of minor extent.

Kennewick soils are on terraces. These soils are very deep and well drained. They formed in lacustrine deposits. Slope is 0 to 25 percent. The soils are silt loam throughout.

Warden soils are on terraces. These soils are very deep and well drained. They formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. The surface layer is silt loam. The subsoil and the substratum to a depth of 60 inches or more are silt loam and very fine sandy loam.

Sagemoor soils are on terraces. These soils are very deep and well drained. They formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. The surface layer and subsoil are silt loam. The substratum to a depth of 60 inches or more is silt loam and very fine sandy loam.

Of minor extent in this unit are Royal soils on terraces and foot slopes; Sagehill, Wahluke, and Novark soils on terraces; and Esquatzel and Cleman soils on alluvial plains. Also of minor extent are somewhat excessively drained Hezel soils on terraces, somewhat excessively drained Quincy soils on terraces and active dunes, and somewhat poorly drained Outlook soils on alluvial plains.

This unit is used mainly for irrigated crops, rangeland, and wildlife habitat.

The main limitations for irrigated crops are the hazards of soil blowing and water erosion and steepness of slope. The production of forage is limited by the low annual precipitation.

2. Timmerman-Quincy

Very deep, somewhat excessively drained, nearly level to steep soils; on terraces and active dunes

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs; however, some areas are barren of vegetation. Elevation is 800 to 2,200 feet. The average annual precipitation is about 7 inches, the

average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 200 days.

This unit makes up about 4 percent of the survey area. It is about 70 percent Timmerman soils and 15 percent Quincy soils. The remaining 15 percent is components of minor extent.

Timmerman soils are on terraces. These soils are very deep and somewhat excessively drained. They formed in sandy glacial outwash and in alluvium that is mixed with eolian material in the upper part. Slope is 0 to 10 percent. The surface layer and subsoil are coarse sandy loam. The substratum to a depth of 60 inches or more is loamy coarse sand and coarse sand.

Quincy soils are on terraces and active dunes. These soils are very deep and somewhat excessively drained. They formed in sand derived from mixed sources. Slope is 0 to 35 percent. The soils are fine sand throughout.

Of minor extent in this unit are well drained Ephrata, Royal, Novark, and Neppel soils.

This unit is used mainly for irrigated crops and wildlife habitat.

The main limitations for irrigated crops are the hazards of soil blowing and water erosion, restricted available water capacity, and steepness of slope.

3. Malaga

Very deep, somewhat excessively drained, nearly level to steep soils; on terraces and terrace escarpments

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 195 days.

This unit makes up about 7 percent of the survey area. It is about 90 percent Malaga soils. The remaining 10 percent is components of minor extent.

Malaga soils are on terraces and terrace escarpments. These soils are very deep and somewhat excessively drained. They formed in gravelly glacial outwash. The surface layer and subsoil are gravelly, very gravelly, or extremely gravelly sandy loam. The substratum to a depth of 60 inches or more is extremely gravelly loamy sand and extremely gravelly coarse sand.

Of minor extent in this unit are well drained Ephrata and Finley soils on terraces and well drained Starbuck, Prosser, and Bakeoven soils on benches. Also of minor extent are somewhat poorly drained Umapine soils on alluvial plains and artificially drained Saltese soils in basins.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by the low annual precipitation and restricted available water capacity. The main limitations for irrigated crops are stones and cobbles on the surface and restricted available water capacity.

4. Ephrata-Malaga

Very deep, well drained and somewhat excessively drained, nearly level to steep soils, on terraces and terrace escarpments

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is about 140 to 195 days.

This unit makes up about 5 percent of the survey area. It is about 60 percent Ephrata soils and 35 percent Malaga soils. The remaining 5 percent is components of minor extent.

Ephrata soils generally are on slightly higher lying terraces. These soils are very deep and well drained. They formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 15 percent. The surface layer is fine sandy loam. The subsoil is gravelly fine sandy loam. The substratum to a depth of 60 inches or more is very gravelly sandy loam and extremely gravelly coarse sand.

Malaga soils generally are on the lower lying terraces and on terrace escarpments. These soils are very deep and somewhat excessively drained. They formed in gravelly glacial outwash. Slope is 0 to 35 percent. The surface layer and subsoil are gravelly and very gravelly sandy loam. The substratum to a depth of 60 inches or more is extremely gravelly loamy sand and extremely gravelly coarse sand.

Of minor extent in this unit are Timmerman, Wiehl, and Neppel soils on terraces; Esquatzel and Cleman soils on alluvial plains; and very poorly drained Aquents.

This unit is used mainly for irrigated crops (fig. 1) and wildlife habitat.

The main limitations for irrigated crops are restricted available water capacity, the hazard of water erosion, and steepness of slope.

5. Burbank-Quincy

Very deep, somewhat excessively drained and excessively drained, nearly level to steep soils on terraces and active dunes

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs; however, some areas are barren of vegetation. Elevation is 300 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 53 degrees F, and the average frost-free season is 135 to 200 days.

This unit makes up about 5 percent of the survey area. It is about 60 percent Burbank soils and 25 percent Quincy soils. The remaining 15 percent is components of minor extent.

Figure 1.-Irrigated crops in area of general map unit 4.

Burbank soils are on terraces. These soils are very deep and excessively drained. They formed in gravelly glacial outwash that has a mantle of eolian sand. Slope is 0 to 15 percent. The surface layer is loamy fine sand. The upper part of the underlying material is loamy fine sand, gravelly loamy fine sand, and gravelly loamy sand, and the lower part is extremely gravelly sand.

Quincy soils are on terraces and active dunes. These soils are very deep and somewhat excessively drained. They formed in sand derived from mixed sources. Slope is 0 to 35 percent. The soils are fine sand throughout.

Of minor extent in this unit are Winchester, Timmerman, and Malaga soils on terraces. Also of minor extent are small areas of Torrifluvents on flood plains adjacent to the Columbia River.

This unit is used mainly as rangeland and for irrigated crops and wildlife habitat.

The production of forage is limited by restricted available water capacity. The main limitations for irrigated crops are the hazard of soil blowing, restricted available water capacity, and steepness of slope.

6. Quincy

Very deep, somewhat excessively drained, nearly level to steep soils on terraces and active dunes

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. This unit supports little if any native vegetation. Elevation is 300 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 135 to 200 days.

This unit makes up about 12 percent of the survey area. It is about 90 percent Quincy soils. The remaining 10 percent is components of minor extent.

Quincy soils are on terraces and active dunes. These soils are very deep and somewhat excessively drained. They formed in sand derived from mixed sources. The soils are fine sand throughout.

Of minor extent in this unit are poorly drained Wanser soils on flood plains and in basins, excessively drained Winchester and Burbank soils on terraces, well drained Torriorthents, and areas of Badland.

This unit is used mainly as rangeland and for irrigated crops and wildlife habitat.

The production of forage is limited by restricted available water capacity. The main limitations for irrigated crops are the hazard of soil blowing, restricted available water capacity, and steepness of slope.

7. Taunton-Scoon

Very shallow, shallow, and moderately deep, well drained, nearly level to steep soils; on terraces and alluvial fans

This map unit is in the southern part of the county. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 3,000 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 110 to 210 days.

This unit makes up about 6 percent of the survey area. It is about 50 percent Taunton soils and 40 percent Scoon soils. The remaining 10 percent is components of minor extent.

Taunton soils are on alluvial fans and terraces. These soils are moderately deep and well drained. They formed in loess and alluvium. Slope is 0 to 35 percent. The surface layer and subsoil are silt loam: The substratum is gravelly silt loam. A hardpan is at a depth of about 27 inches. Depth to the hardpan ranges from 20 to 40 inches.

Scoon soils are on terraces and alluvial fans. These soils are shallow and very shallow and are well drained. They formed in loess. Slope is 0 to 15 percent. The surface layer and subsoil are silt loam. The substratum is gravelly silt loam. A hardpan is at a depth of about 16 inches. Depth to the hardpan ranges from 6 to 20 inches.

Of minor extent in this unit are Finley soils on alluvial fans; Wiehl, Neppel, Kennewick, and Royal soils on terraces; and Prosser soils on benches.

This unit is used mainly as rangeland and for irrigated crops and wildlife habitat.

The production of forage is limited by restricted available water capacity. The main limitations for irrigated crops are the hazards of soil blowing and water erosion, restricted available water capacity, and steepness of slope.

8. Ekrub-Koehler

Shallow and moderately deep, somewhat excessively drained, nearly level to moderately steep soils; on terraces

This map unit is in the southern part of the survey area. Slope is 0 to 25 percent. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 150 to 200 days.

This unit makes up about 2 percent of the survey area. It is about 50 percent Ekrub soils and 30 percent Koehler soils. The remaining 20 percent is components of minor extent.

Ekrub soils are on terraces. These soils are shallow and somewhat excessively drained. They formed in eolian sand. Slope is 0 to 25 percent. The surface layer is fine sand. The underlying material is fine sand and very gravelly fine sand. A hardpan is at a depth of about 18 inches. Depth to the hardpan ranges from 14 to 20 inches.

Koehler soils are on terraces. These soils are moderately deep and somewhat excessively drained. They formed in eolian sand. Slope is 0 to 10 percent. The surface layer and upper part of the underlying material are loamy fine sand. The lower part of the underlying material is very gravelly fine sand. A hardpan is at a depth of about 33 inches. Depth to the hardpan ranges from 20 to 40 inches.

Of minor extent in this unit are Quincy soils on terraces and active dunes, Schawana soils on benches, well drained Prosser soils on benches, and well drained Taunton soils on terraces.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity. The main limitations for irrigated crops are the hazards of soil blowing and water erosion and steepness of slope.

9. Farrell-Ellisforde

Very deep, well drained, nearly level to strongly sloping soils on terraces

This map unit is in the northern part of the survey area. Slope is 0 to 15 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 160 days.

This unit makes up about 1 percent of the survey area. It is about 65 percent Farrell soils and 25 percent Ellisforde soils. The remaining 10 percent is components of minor extent.

Farrell soils are on terraces. These soils are very deep and well drained. They formed in glacial deposits that have a mantle of loess. Slope is 0 to 10 percent. The surface layer and subsoil are very fine sandy loam. The substratum to a depth of 60 inches or more is fine sandy loam, silt loam, and very fine sandy loam.

Ellisforde soils are on terraces. These soils are very deep and well drained. They formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. The surface layer and subsoil are silt loam. The substratum to a depth of 60 inches or more is very fine sandy loam and silt loam.

Of minor extent in this unit are Ritzville and Renslow soils on hills and stony Strat soils on terraces.

This unit is used for nonirrigated and irrigated crops and for wildlife habitat.

The main limitations for nonirrigated crops are the low annual precipitation and the hazards of soil blowing and water erosion. The main limitations for irrigated crops are the hazards of water erosion and soil blowing and steepness of slope.

10. Strat-Magallon-Stratford

Very deep, well drained and somewhat excessively drained, nearly level to moderately steep soils; on terraces

This map unit is in the northern part of the survey area. Slope is 0 to 25 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 165 days.

This unit makes up about 4 percent of the survey area. It is about 80 percent Strat soils, 10 percent Magallon soils, and 5 percent Stratford soils. The remaining 5 percent is components of minor extent.

Strat soils are on terraces. These soils are very deep and well drained. They formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 25 percent. The surface layer is stony loam. The subsoil is very gravelly loam. The upper part of the substratum is very cobbly loam, and the lower part is extremely gravelly coarse sand.

Magallon soils are on terraces. These soils are very deep and somewhat excessively drained. They formed in sandy glacial outwash. Slope is 0 to 10 percent. The surface layer and subsoil are sandy loam. The upper part of the substratum is loamy sand, and the lower part to a depth of *60* inches or more is coarse sand.

Stratford soils are on terraces. These soils are very deep and well drained. They formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 15 percent. The surface layer is loam. The subsoil is gravelly loam. The upper part of the substratum is gravelly loam, and the lower part to a depth of 60 inches or more is extremely gravelly coarse sand.

Of minor extent in this unit are Bakeoven and Roloff soils on benches, Farrell soils on terraces, and Hermiston soils on alluvial plains. Also of minor extent are artificially drained Saltese soils in basins, somewhat poorly drained Outlook and Pedigo soils on alluvial plains, and somewhat excessively drained Quincy soils on terraces and active dunes.

This unit is used mainly as rangeland and for irrigated crops and wildlife habitat.

The production of forage is limited by restricted available water capacity. The main limitations for irrigated crops are the restricted available water capacity and the hazard of water erosion.

soils on benches, terraces, hillsides, and ridgetops in areas of Channeled Scablands

This group consists of four map units. It makes up about 16 percent of the survey area. The soils in this group are nearly level to very steep. The native vegetation is mainly grasses and shrubs.

The soils in this group are very shallow to very deep and are well drained and somewhat excessively drained. They formed in loess, material derived from basalt, eolian deposits, and glacial outwash.

This group is used mainly as rangeland and for wildlife habitat.

11. Starbuck-Bakeoven-Prosser

Very shallow, shallow, and moderately deep, well drained, nearly level to very steep soils; on benches, hillsides, and ridgetops

This map unit is in the southern part of the survey area. Slope is 0 to *65* percent. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,900 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 110 to 210 days.

This unit makes up about *6* percent of the survey area. It is about *35* percent Starbuck soils, 30 percent Bakeoven soils, and 20 percent Prosser soils. The remaining *15* percent is components of minor extent.

Starbuck soils are on benches, hillsides, and ridgetops. These soils are shallow and well drained. They formed in loess and in material derived from basalt. Slope is 0 to 65 percent. The surface layer is very fine sandy loam. The subsoil is silt loam. Basalt is at a depth of about 15 inches. Depth to basalt ranges from 12 to 20 inches.

Bakeoven soils are on benches, hillsides, and ridgetops. These soils are very shallow and well drained. They formed in loess and in material derived from basalt. Slope is 0 to 55 percent. The surface layer is very cobbly loam. The subsoil is very gravelly loam. Basalt is at a depth of about 7 inches. Depth to basalt ranges from 4 to 12 inches.

Prosser soils are on benches and hillsides. These soils are moderately deep and well drained. They formed in loess. Slope is 0 to 45 percent. The soils are very fine sandy loam. Basalt is at a depth of about 26 inches. Depth to basalt ranges from 20 to 40 inches.

Of minor extent in this unit are Ephrata soils on terraces, somewhat excessively drained Malaga soils on terraces, Finley soils on alluvial fans, Kiona soils on hillsides, and Neppel soils on terraces. Also of minor extent are somewhat poorly drained Kittitas soils on alluvial plains, somewhat poorly drained Umapine soils in basins, very poorly drained Aquents, and Rock outcrop.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity.

12. Schawana

Shallow, somewhat excessively drained, nearly level to very steep soils; on benches and hillsides

This map unit is in the southern part of the survey area. Slope is 0 to 55 percent. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 140 to 200 days.

This unit makes up about 2 percent of the survey area. It is about 90 percent Schawana soils. The remaining 10 percent is components of minor extent.

Schawana soils are on benches and hillsides. These soils are shallow and somewhat excessively drained. They formed in eolian deposits and in material derived from basalt. The surface layer is cobbly loamy fine sand. The underlying material is gravelly very fine sandy loam. Basalt is at a depth of about 12 inches. Depth to basalt ranges from 8 to 20 inches.

Of minor extent in this unit are Quinton soils on benches, Quincy soils on terraces and active dunes, and Ekrub and Koehler soils on terraces. Also of minor extent are excessively drained Winchester and Burbank soils on terraces and somewhat poorly drained Kittitas and Umapine soils on alluvial plains.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity.

13. Bakeoven-Roloff

Very shallow and moderately deep, well drained, nearly level to very steep soils; on hillsides, benches, and ridgetops

This map unit is in the southern part of the survey area. Slope is 0 to 55 percent. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 110 to 180 days.

This unit makes up about 7 percent of the survey area. It is about 35 percent Bakeoven soils and 25 percent Roloff soils. The remaining 40 percent is components of minor extent.

Bakeoven soils are on ridgetops, hillsides, and benches. These soils are very shallow and well drained. They formed in loess and in material derived from basalt. Slope is 0 to 55 percent. The surface layer is very cobbly loam. The subsoil is very gravelly loam. Basalt is at a depth of about 7 inches. Depth to basalt ranges from 4 to 12 inches.

Roloff soils are on benches and hillsides. These soils are moderately deep and well drained. They formed in loess. Slope is 0 to 25 percent. These soils are silt loam. Basalt is at a depth of about 29 inches. Depth to basalt ranges from 20 to 40 inches.

Of minor extent in this unit are Touhey and Timentwa soils on till plains and plateaus, Starbuck soils on benches, Entiat and Kiona soils on hillsides, Strat and Farrell soils on terraces, and Renslow soils on hills. Also of minor extent are somewhat excessively drained Magallon soils on terraces, Finley soils on alluvial fans, somewhat poorly drained Umapine and Ahtanum soils in basins and on alluvial plains, Rubble land, and Rock outcrop.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity.

14. Bakeoven-Anders-Benco

Very shallow, moderately deep, and very deep, well drained, nearly level to very steep soils; on ridgetops hillsides, benches, and terraces

This map unit is in the northern part of the survey area. Slope is 0 to 55 percent. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,900 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 110 to 180 days.

This unit makes up about 1 percent of the survey area. It is about 40 percent Bakeoven soils, 25 percent Anders soils, and 20 percent Benco soils. The remaining 15 percent is components of minor extent.

Bakeoven soils are on ridgetops, hillsides, and benches. These soils are very shallow and well drained. They formed in loess and in material derived from basalt. Slope is 0 to 55 percent. The surface layer is very cobbly loam. The subsoil is very gravelly loam. Basalt is at a depth of about 7 inches. Depth to basalt ranges from 4 to 12 inches.

Anders soils are on benches. These soils are moderately deep and well drained. They formed in loess. Slope is 0 to 10 percent. The surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is gravelly silt loam. Basalt is at a depth of about 23 inches. Depth to basalt ranges from 20 to 40 inches.

Benco soils are on terraces. These soils are very deep and well drained. They formed in gravelly glacial outwash that is mixed with loess in the upper part. Slope is 0 to 15 percent. The surface layer is stony loam. The subsoil is very gravelly loam. The substratum to a depth of 60 inches or more is extremely gravelly coarse sand.

Of minor extent in this unit are Entiat and Badge soils on hillsides, Chard soils on terraces, somewhat poorly drained Pedigo soils on alluvial plains, Rubble land, and Rock outcrop.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity.

soils mainly on hills and ridgetops

This group consists of six map units. It makes up about 27 percent of the survey area. The soils in this group are nearly level to very steep. The native vegetation is mainly grasses and shrubs.

The soils in this group are shallow to very deep and are well drained. They formed in loess and in colluvium derived from loess and basalt.

This group is used mainly for nonirrigated and irrigated crops, rangeland, and wildlife habitat.

15. Adkins

Very deep and deep, well drained, nearly level to steep soils; on hills

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 150 to 200 days.

This unit makes up about 2 percent of the survey area. It is about 75 percent Adkins soils. The remaining 25 percent is components of minor extent.

Adkins soils are on hills. These soils are very deep and deep and are well drained. They formed in loess. The soils are very fine sandy loam throughout.

Of minor extent in this unit are Taunton soils on alluvial fans, Starbuck soils on hillsides, Kennewick soils on terraces, somewhat excessively drained Quincy soils on terraces and active dunes, and somewhat excessively drained Ekrub and Koehler soils on terraces.

This unit is used mainly for nonirrigated crops, rangeland, and wildlife habitat.

The main limitations for nonirrigated crops are the low annual precipitation and the hazards of soil blowing and water erosion. The production of forage is limited by the low annual precipitation. The main limitations for irrigated crops are the hazards of soil blowing and water erosion and the steepness of slope.

16. Shano

Very deep, well drained, nearly level to steep soils on hills

This map unit is in the southern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 150 to 200 days.

This unit makes up about 4 percent of the survey area. It is about 95 percent Shano soils. The remaining 5 percent is components of minor extent.

Shano soils are on hills. These soils are very deep and well drained. They formed in loess. The soils are silt loam throughout.

Of minor extent in this unit are moderately deep Burke soils on hills, Prosser soils on hillsides, Warden soils on terraces, and Cleman soils on alluvial plains.

This unit is used mainly for nonirrigated and irrigated crops and for wildlife habitat.

The main limitations for nonirrigated crops are the low annual precipitation and the hazard of water erosion. The main limitations for irrigated crops are the hazard of water erosion and steepness of slope.

17. Shano-Kiona-Starbuck

Shallow and very deep, well drained, nearly level to very steep soils on benches, hills, and ridgetops

This map unit is in the southern part of the survey area. Slope is 0 to 65 percent. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,700 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 210 days.

This unit makes up about 2 percent of the survey area. It is about 45 percent Shano soils, 35 percent Kiona soils, and 10 percent Starbuck soils. The remaining 10 percent is components of minor extent.

Shano soils are on hills. These soils are very deep and well drained. They formed in loess. Slope is 0 to 35 percent. The soils are silt loam throughout.

Kiona soils are on hillsides. These soils are very deep and well drained. They formed in colluvium derived from loess and basalt. Slope is 25 to 65 percent. The surface layer and subsoil are cobbly very fine sandy loam. The substratum is very cobbly sandy loam.

Starbuck soils are on ridgetops and hillsides; These soils are shallow and well drained. They formed in loess and in material derived from basalt. Slope is 0 to 65 percent. The surface layer is very fine sandy loam. The subsoil is silt loam. Basalt is at a depth of about 15 inches. Depth to basalt is 12 to 20 inches.

Of minor extent in this unit are Prosser and Lickskillet soils on hillsides; Bakeoven soils on ridgetops and hillsides; Rubble land; and Rock outcrop.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity.

18. Zen-Lickskillet-Ralls

Shallow, moderately deep, and very deep, well drained, nearly level to very steep soils; on hillsides and ridgetops

This map unit is in the northern part of the survey area. Slope is 0 to 65 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 160 days.

This unit makes up about 5 percent of the survey area. It is about 45 percent Zen soils, 20 percent Lickskillet soils, and 15 percent Rails soils. The remaining 20 percent is components of minor extent.

Zen soils are on hillsides and ridgetops. These soils are moderately deep and well drained. They formed in loess. Slope is 0 to 45 percent. The soils are silt loam. Basalt is at a depth of about 28 inches. Depth to basalt ranges from 20 to 40 inches.

Lickskillet soils are on hillsides. These soils are shallow and well drained. They formed in colluvium derived from loess and basalt. Slope is 5 to 65 percent. The surface layer is very cobbly loam. The subsoil is very gravelly loam. Basalt is at a depth of about 15 inches. Depth to basalt ranges from 12 to 20 inches.

Rails soils are on hillsides. These soils are very deep and well drained. They formed in colluvium derived from basalt and loess. Slope is 3 to 45 percent. The surface layer and subsoil are silt loam. The substratum to a depth of 60 inches or more is very gravelly silt loam and gravelly clay loam.

Of minor extent in this unit are Bakeoven soils on ridgetops, Renslow soils on hills, Willis soils on terraces and hills, Roloff soils on hillsides, Prosser and Starbuck soils on benches, Strat soils on terraces, and somewhat poorly drained Pedigo and Umapine soils on alluvial plains.

This unit is used mainly as rangeland and for wildlife habitat.

The production of forage is limited by restricted available water capacity of the Lickskillet and Zen soils.

Figure 2.-Nonirrigated crops in an area of general map unit 19.

Figure 3.-An area of general map unit 20. The area is on hills that have a mantle of loess.

19. Renslow-Ritzville

Very deep, well drained, nearly level to steep soils; on hills

This map unit is in the northern part of the survey area. Slope is 0 to 35 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 160 days.

This unit makes up about 12 percent of the survey area. It is about 55 percent Renslow soils and 10 percent Ritzville soils. The remaining 35 percent is components of minor extent.

Renslow soils are on hills. These soils are very deep and well drained. They formed in loess. Slope is 0 to 35 percent. The soils are silt loam throughout.

Ritzville soils are on hills. These soils are very deep and well drained. They formed in loess. Slope is 0 to 25 percent. The soils are silt loam throughout.

Of minor extent in this unit are Willis soils on terraces and hills; Zen soils on ridgetops and hillsides; Farrel soils on terraces; Bakeoven, Lickskillet, and Ralls soils on hillsides; Esquatzel soils on alluvial plains; and somewhat poorly drained Pedigo soils on alluvial plains.

This unit is used mainly for nonirrigated crops (fig. 2) and wildlife habitat.

The main limitations for nonirrigated crops are the hazard of water erosion and the low annual precipitation.

20. Bagdad

Very deep, well drained, nearly level to moderately steep soils on hills

This map unit is in the northern part of the survey area. Slope is 0 to 20 percent. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 2,700 feet. The average annual precipitation, is about 13 inches, the average annual air temperature is about 47

degrees F, and the average frost-free season is 110 to 140 days.

This unit makes up about 2 percent of the survey area. It is about 80 percent Bagdad soils. The remaining 20 percent is components of minor extent.

Bagdad soils are on hills (fig. 3). These soils are very deep and well drained. They formed in loess. The soils are silt loam throughout.

Of minor extent in this unit are the Chard soils on terraces, Endicott soils on hills, Condon and Bakeoven soils on hillsides, Hermiston soils on alluvial plains, and somewhat poorly drained Pedigo soils on alluvial plains.

This unit is mainly used for nonirrigated crops and wildlife habitat.

The main limitations for nonirrigated crops are the hazard of water erosion and the low annual precipitation.

broad land use considerations

The soils of Grant County vary widely in their suitability for major land uses. Approximately 19 percent of the county is used as irrigated cropland. Among the crops grown are winter wheat, alfalfa hay, potatoes, corn, beans, and pasture. The irrigated cropland is mainly in the southern part of the country. It is predominantly in general soil map units 1, 2, 4, 5, 6, 7, 9, 10, and 16. The major soils in these units are Burbank, Ellisforde, Ephrata, Farrell, Kennewick, Malaga, Sagemoor, Timmerman, and Warden soils on terraces; Quincy soils on active dunes; Scoon and Taunton soils on alluvial fans; and Shano soils on hills. The Burbank, Ephrata, Farrell, Kennewick, Quincy, Scoon, Taunton, and Timmerman soils are subject to soil blowing.

Approximately 18 percent of the county is used as nonirrigated cropland. The main crop is winter wheat. The nonirrigated cropland is mainly in the northern part of the county. It is predominantly in general soil map units 9, 15, 16, 19, and 20. The major soils in these units are Adkins, Bagdad, Renslow, Ritzville, and Shano soils on hills and Ellisforde and Farrell soils on terraces. The main limitations for nonirrigated crops are the low average annual precipitation and the hazard of water erosion. The Farrell, Ellisforde, and Adkins soils are also subject to soil blowing.

About 63 percent of the county is used as rangeland. The rangeland is mainly in general soil map units 1, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 17, and 18. The major soils in these units are Anders, Bakeoven, Kiona, Lickskillet, Ralls, Roloff, Schawana, Starbuck, and Zen soils on benches, hillsides, and ridgetops and Benco, Ekrub, Koehler, Magallon, Malaga, Strat, Stratford, and Quincy soils on active dunes of terraces. The main limitations for the production of forage are the low average annual precipitation and low available water capacity.

About 2,400 acres in the county is classified as Urban land. In general, the nearly level to sloping soils in general soil map units 1, 2, 9, 15, 16, 19, and 20 are well suited to use as building sites. Map units 7, 8, 11, 12, 13, 14, and 18 and the Starbuck soils in unit 17 generally have severe limitations for use as building sites and for sanitary facilities because of the depth to basalt and depth to the cemented pan. Map units 2, 3, 4, 5, 6, and 10 and the Farrell soils in unit 9 are severely limited for septic tank absorption fields because the effluent may contaminate nearby water supplies.

The suitability of the soils in the county for recreation is low to high depending on the intensity of expected use and the properties of the soils. Most areas of general soil map units 1, 2, 4, 5, 9, 15, 16, 19, and 20 are suited to recreation. Map units 11, 12, 13, and 14 and parts of units 17 and 18 generally are poorly suited to recreation because of the depth to basalt.

The suitability for wildlife habitat varies throughout the county. Soils in general soil map units 1, 2, 4, 9, 16, and 19 are well suited to openland wildlife when irrigated.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Shano silt loam, 0 to 2 percent slopes, is one of several phases in the Shano series.

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

A soil complex consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Malaga-Ephrata complex, 0 to 15 percent slopes, is an example.

A soil association is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Renslow association is an example.

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

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

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

1-Adkins loamy fine sand, 5 to 15 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown loamy fine sand 10 inches thick. The subsoil is brown very fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Adkins very fine sandy loam, Taunton loamy fine sand, Koehler loamy fine sand, and Adkins soils that have slopes of less than 5 percent.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage such as rabbitbrush increases. Seeding generally is not practical because of the low annual precipitation and the hazard of soil blowing.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazard of soil blowing. Many kinds of cultivated crops, such as small grain, potatoes, corn, alfalfa, and peas, can be grown under irrigation. Sprinkler, drip, or trickle irrigation is suited to this unit.

Winter cover crops protect the soil from soil blowing. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Low-residue crops can be grown if the unit is adequately protected against soil blowing. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

2-Adkins very fine sandy loam, 0 to 5 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Adkins loamy fine sand; Shano silt loam; Taunton fine sandy loam; Adkins very fine sandy loam, cemented substratum; and Adkins soils that have slopes of more than 5 percent.

This unit is used for nonirrigated crops and as rangeland. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

If the range is in good or excellent condition, the native vegetation is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, corn, alfalfa, beans, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation systems are suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also increases the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Winter cover crops protect the soil from soil blowing. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

3-Adkins very fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Adkins loamy fine sand; Shano silt loam; Taunton fine sandy loam; Adkins very fine sandy loam, cemented substratum; and Adkins soils that have slopes of more than 10 percent.

This unit is used mainly for nonirrigated crops and as rangeland. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are low precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is low precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazards of soil blowing and water erosion. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, corn, alfalfa, beans, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts expose the calcareous substratum.

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

4-Adkins very fine sandy loam, 10 to 15 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The soil is brown very fine sandy loam 17 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Adkins loamy fine sand; Shano silt loam; Taunton fine sandy loam; Adkins very fine sandy loam, cemented substratum; and Adkins soils that have slopes of more than 15 percent.

This unit is used mainly for nonirrigated crops and as rangeland. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are low precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs

can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is low precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazards of soil blowing and water erosion. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain and alfalfa.

Sprinkler, drip, or trickle irrigation is suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

5-Adkins very fine sandy loam, 15 to 35 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Adkins loamy fine sand; Shano silt loam; Taunton fine sandy loam; Adkins very fine sandy loam, cemented substratum; and Adkins soils that have slopes of more than 35 percent.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are low precipitation and the hazards of soil blowing and water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Erosion is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used.

The potential plant community on this unit is mainly bluebunch wheatgrass, Cusick bluegrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitation of this unit for rangeland seeding is low precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass IVe, nonirrigated.

6-Adkins very fine sandy loam, cemented substratum, 0 to 5 percent slopes. This well drained soil is on hills. It is deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum is pale brown very fine sandy loam 18 inches thick. A hardpan is at a depth of 42 inches. Depth to the hardpan ranges from 40 to 60 inches. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Taunton fine sandy loam; Adkins very fine sandy loam; Adkins loamy fine sand; Shano silt loam; Prosser very fine sandy loam; and Adkins soils that have a cemented substratum and have slopes of more than 5 percent.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are low precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, corn, alfalfa, beans, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also increases the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer, also increases the water intake rate and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

7-Adkins very fine sandy loam, cemented substratum, 5 to 10 percent slopes. This well drained soil is on hills. It is deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum is pale brown very fine sandy loam 18 inches thick. A hardpan is at a depth of 42 inches. Depth to the hardpan ranges from 40 to 60 inches. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Taunton fine sandy loam, Adkins very fine sandy loam, Adkins loamy fine sand, Shano silt loam, Prosser very fine sandy loam, and Adkins soils that have a cemented substratum and have slopes of more than 10 percent.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are low precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazards of soil blowing and water erosion. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, corn, alfalfa, beans, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer, also increases the water intake rate and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduces erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

8-Adkins very fine sandy loam, cemented substratum, 10 to 15 percent slopes. This well drained soil is on hills. It is deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum is pale brown very fine sandy loam 18 inches thick. A hardpan is at a depth

of 42 inches. Depth to the hardpan ranges from 40 to 60 inches. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Taunton fine sandy loam, Adkins very fine sandy loam, Adkins loamy fine sand, Shano silt loam, Prosser very fine sandy loam, and Adkins soils that have a cemented substratum and have slopes of more than 15 percent.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are low precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazards of soil blowing and water erosion. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain and alfalfa. Sprinkler, drip, or trickle irrigation is suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

9-Adkins very fine sandy loam, cemented substratum, 15 to 35 percent slopes. This well drained soil is on hills. It is deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 and 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is brown very fine sandy loam 7 inches thick. The subsoil is brown very fine sandy loam 17 inches thick. The substratum is pale brown very fine sandy loam 18 inches thick. A hardpan is at a depth of 42 inches. Depth to the hardpan ranges from 40 to 60 inches. The soil is calcareous in the substratum.

Permeability of this Adkins soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Taunton fine sandy loam, Adkins very fine sandy loam, Adkins loamy fine sand, Shano silt loam, Prosser very fine sandy loam, and Adkins soils that have a cemented substratum and have slopes of more than 35 percent.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are steepness of slope, low precipitation, and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used.

The potential plant community on this unit is mainly bluebunch wheatgrass, Cusick bluegrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are low precipitation and steepness of slope. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass IVe, nonirrigated.

10-Ahtanum silt loam. This somewhat poorly drained, salt- and sodium-affected soil is on alluvial plains and in basins. It is moderately deep over a hardpan. The soil formed in silty alluvium. Slope is 0 to 5 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,400 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 130 days.

Typically, the surface layer is brown silt loam 7 inches thick. The upper part of the underlying material is light

brownish gray silt loam 14 inches thick. The next part is a weakly cemented hardpan 9 inches thick. Below this to a depth of 60 inches or more is light gray and pale brown silt loam and light olive gray very fine sandy loam. The soil is calcareous throughout. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Ahtanum soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 12 and 24 inches in January through May. This soil is subject to frequent periods of flooding in January through April. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent soils that are underlain by basalt at a depth of 40 to 60 inches. Also included is about 10 percent Pedigo silt loam.

This unit is used as rangeland.

The potential plant community on this unit is mainly basin wildrye, inland saltgrass, and alkali cordgrass. The production of forage is limited by excess salt and sodium and depth to the hardpan. If the range is overgrazed, the proportion of preferred forage plants such as basin wildrye decreases and the proportion of less preferred forage plants such as inland saltgrass, alkali cordgrass, and black greasewood increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are excess salt and sodium and low precipitation. Proper timing of seeding is critical to the establishment of seedlings. Among the grasses that are suitable for seeding are tall wheatgrass and other salt-tolerant grasses.

This map unit is in capability subclass VIw, nonirrigated.

11-Anders silt loam, 0 to 10 percent slopes. This moderately deep, well drained soil is on benches. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 2,200 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 48 degrees F, and the average frost-free season is about 125 days.

Typically, the surface layer is dark grayish brown silt loam 8 inches thick. The subsoil is brown silt loam and gravelly silt loam 15 inches thick. Basalt is at a depth of 23 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Anders soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 15 percent soils that are underlain by basalt at a depth of less than 20 inches or more than 40 inches. Also included are small areas of soils that have a cobbly surface layer.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are low precipitation, the hazard of water erosion, and the moderate available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are low precipitation and the moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass IIIe, nonirrigated.

12-Aquents, ponded. These very deep, very poorly drained soils are in basins. They formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly cattails and sedges. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 135 days.

No one profile is typical of Aquents, ponded, but one commonly observed in the survey area has a surface layer of gray silty clay loam 14 inches thick. The underlying material to a depth of 60 inches or more is gray silty clay loam and silt loam. The soils are calcareous throughout. The texture of these soils varies within short distances. In places the upper part of the underlying material ranges from silty clay loam to sandy loam, and the lower part is silt loam or gravelly sandy loam. Basalt is at a depth of more than 20 inches in some places.

Included in this unit is about 20 percent Wanser loamy fine sand, Kittitas silt loam, and Umapine silt loam.

Permeability of these Aquents, ponded, is moderately slow. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at or near the surface. Runoff is ponded, and the hazard of water erosion is slight.

This unit is used for wildlife habitat.

This unit provides waterholes for animals in summer. It also provides nesting areas for migratory waterfowl.

This map unit is in capability subclass VIIw, nonirrigated.

13-Badge-Bakeoven complex, 25 to 55 percent slopes. This map unit is on hillsides and benches. The native vegetation is mainly grasses and shrubs. Elevation is 1,800 to 2,900 feet. The average annual precipitation is about 12 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 130 days.

This unit is 45 percent Badge cobbly loam and 35 percent Bakeoven very cobbly loam. The Badge soil is on hillsides, and the Bakeoven soil is on hillsides and benches. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 15 percent Condon silt loam and soils that are underlain by basalt at a depth of 12 to 20 inches. Also included is about 5 percent Rock outcrop on convex side slopes and Rubble land in lower lying areas adjacent to the Rock outcrop.

The Badge soil is very deep and well drained. It formed in colluvium derived from loess and in material weathered from basalt. Typically, the upper 9 inches of the surface layer is dark grayish brown cobbly loam and the lower 7 inches is dark brown very cobbly loam. The subsoil is yellowish brown extremely cobbly loam and very cobbly loam 17 inches thick. The substratum to a depth of 60 inches or more is yellowish brown very gravelly loam.

Permeability of this Badge soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very high.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material weathered from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is very rapid, and the hazard of water erosion is very high.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, threetip sagebrush, and stiff sagebrush. The production of forage is limited by the very low available water capacity of the Bakeoven soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of the steepness of slope, the very shallow depth of the Bakeoven soil, and cobbles on the surface.

This map unit is in capability subclass VIIs, nonirrigated.

14-Badland-Torriorthents complex, very steep. This map unit is on hills. Elevation is 380 to 1,000 feet. The native vegetation is mainly shrubs and forbs, and it grows mainly on the Torriorthents part of the unit. Slope is 30 to 80 percent. The average annual precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 180 days.

This unit is about 45 percent Badland and 40 percent Torriorthents. The Badland is on back slopes and shoulders, and the Torriorthents are on foot slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 15 percent Quincy loamy fine sand and Quincy fine sand.

Badland consists of nearly barren areas of exposed semiconsolidated lacustrine sediment.

Torriorthents are very deep, well drained soils that formed in lacustrine sediment. No one profile is typical of Torriorthents, but one commonly observed in the survey area has a surface layer of light brownish gray silt loam about 2 inches thick. The underlying material to a depth of 60 inches or more is grayish brown, light brownish gray, and white silty clay loam. It is semiconsolidated below a depth of 10 to 20 inches. In places the surface layer is very fine sandy loam or loamy fine sand. The texture of these soils varies widely throughout the profile and within short distances.

Permeability of these Torriorthents is moderately slow. Available water capacity is moderate. Effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very high.

This unit is used for wildlife habitat.

The potential native vegetation is mainly winterfat, bladderpod, and helianthella. Grazing is limited by very low forage production and by the difficulty of animal movement on the very steep slopes.

This map unit is in capability class VIII.

15-Bagdad silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 125 days.

Typically, the surface layer is dark grayish brown and brown silt loam 13 inches thick. The subsoil is pale brown and light yellowish brown silt loam 23 inches thick. The substratum to a depth of 60 inches or more is

pale brown silt loam. The soil is calcareous in the substratum (fig. 4).

Included in this unit is about 20 percent soils that have a surface layer more than 20 inches thick and Bagdad soils that have slopes of more than 5 percent.

This unit is used for nonirrigated crops.

If this unit is used for nonirrigated crops, the main limitation is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. A 3-year rotation of winter wheat, spring grain, and summer fallow may also be used, especially after a winter of higher than normal precipitation.

Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff. Level terraces can be used on the long slopes to control runoff.

This map unit is in capability subclass IIe, nonirrigated.

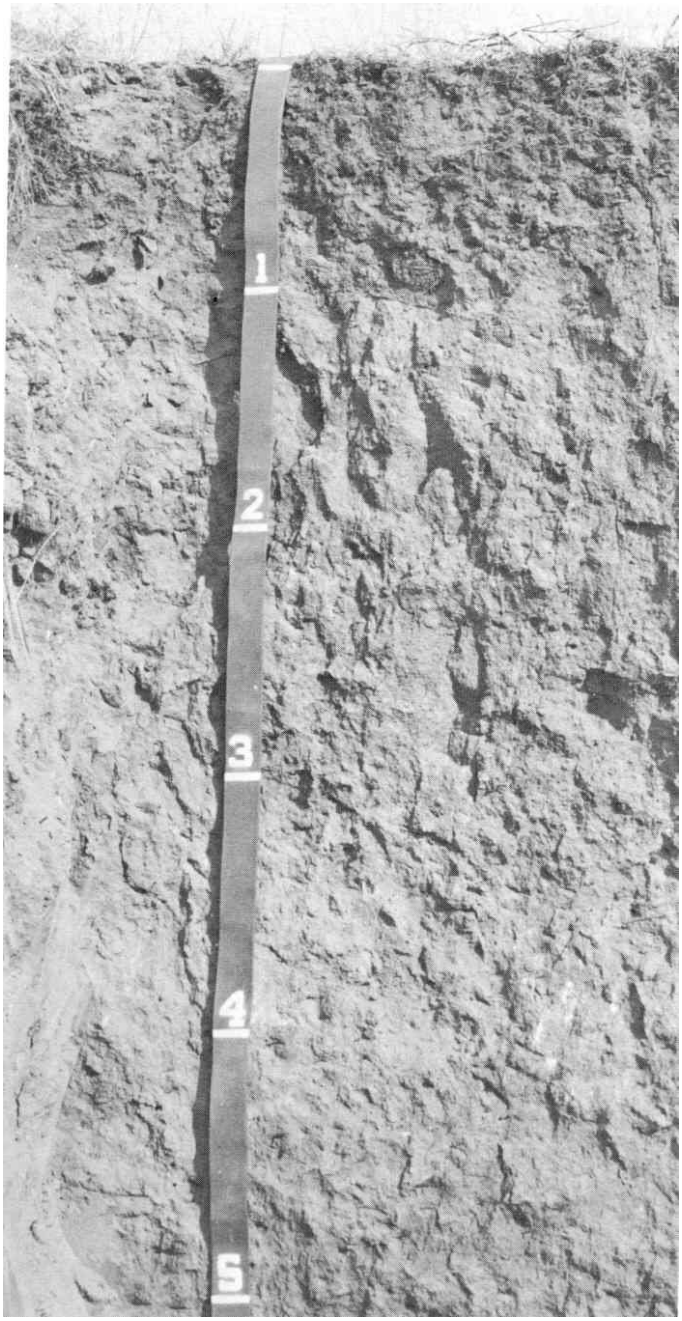

Figure 4.-Profile of Bagdad silt loam, 0 to 5 percent slopes.

16-Bagdad silt loam, 5 to 20 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 125 days.

Typically, the surface layer is dark grayish brown and brown silt loam 13 inches thick. The subsoil is pale brown and light yellowish brown silt loam 23 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous in the substratum.

Permeability of this Bagdad soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of ,water erosion is moderate.

Included in this unit is about 15 percent soils that have a surface layer more than 20 inches thick. Also included is about 10 percent Bagdad soils that have slopes of more than 20 percent, Endicott silt loam on south-facing side slopes, eroded soils on convex side slopes, soils that are underlain by basalt at a depth of less than 20 inches, and moderately well drained soils along drainageways.

This unit is used for nonirrigated crops.

If this unit is used for nonirrigated crops, the main limitations are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable.

Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff. Terraces can be used on the more nearly level slopes to control runoff.

This map unit is in capability subclass IIIe, nonirrigated.

17-Bagdad-Endicott silt loams, 7 to 20 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is

2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 125 days.

This unit is 40 percent Bagdad silt loam and 30 percent Endicott silt loam. The Bagdad soil is in smooth and concave areas, and the Endicott soil is in convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 20 percent severely eroded soils in convex areas and soils that have a silty clay loam subsoil. Also included is about 10 percent soils, in concave areas, that have a surface layer more than 20 inches thick and Bagdad and Endicott soils that have slopes of more than 20 percent.

The Bagdad soil is very deep and well drained. It formed in loess. Typically, the surface layer is dark grayish brown and brown silt loam 13 inches thick. The subsoil is pale brown and light yellowish brown silt loam 23 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous in the substratum.

Permeability of the Bagdad soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Endicott soil is well drained. It is moderately deep over a hardpan. The soil formed in loess. Typically, the surface layer is grayish brown silt loam 7 inches thick. The subsoil is brown silt loam 14 inches thick. The substratum is white silt loam 4 inches thick. A hardpan is at a depth of 25 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Endicott soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated crops.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

This map unit is in capability subclass IVe, nonirrigated.

18-Bakeoven very cobbly loam, 0 to 35 percent slopes. This very shallow, well drained soil is on ridgetops, hillsides, and benches. It formed in loess and in material derived from basalt. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Included in this unit is about 20 percent soils that are underlain by basalt at a depth of 12 to 20 inches, soils that have a stony surface layer, and Rock outcrop.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on the Bakeoven soil is mainly Sandberg bluegrass, stiff sagebrush, and buckwheat. The production of forage is limited by the very low available water capacity and cobbles on the surface. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass decreases and the proportion of less preferred forage plants such as cheatgrass and sixweeks fescue increases. Seeding on this unit generally is not practical because of the very low available water capacity, the very cobbly surface layer, and the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

19-Bakeoven-Anders complex, 0 to 15 percent slopes. This map unit is on benches (fig. 5). The native vegetation is mainly grasses and shrubs. Elevation is 2,200 to 2,500 feet. The average annual precipitation is about 12 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 125 days.

This unit is 45 percent Bakeoven very cobbly loam and 30 percent Anders silt loam. The Bakeoven soil is between mounds, and the Anders soil is on mounds. The mounds are 20 to 30 feet in diameter, 15 to 100 feet apart, and 1 foot to 4 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit between mounds is about 20 percent soils that are underlain by basalt at a depth of 12 to 20 inches, Benco stony loam, Rock outcrop, and somewhat poorly drained soils in depressional areas. Included on mounds is about 5 percent soils that have a carbonate accumulation overlying basalt and soils that have basalt at a depth of more than 40 inches. Also

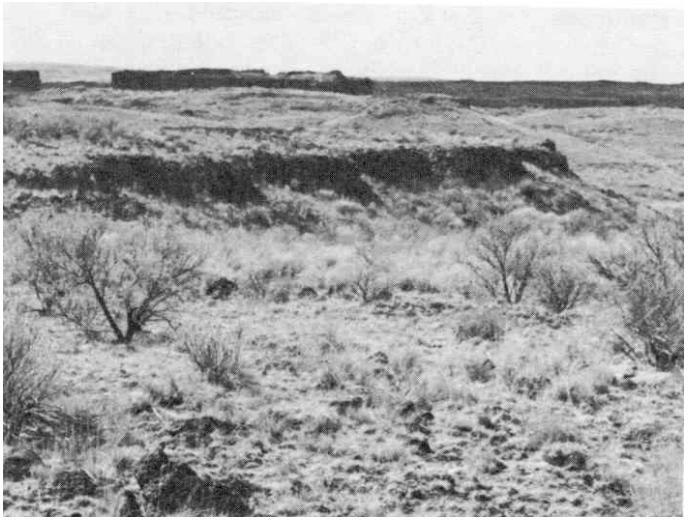

Figure 5.-Bakeoven-Anders complex, 0 to 15 percent slopes, in an area of Channeled Scablands.

included are small areas of Bakeoven and Anders soils that have slopes of more than 15 percent.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Anders soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam 8 inches thick. The subsoil is brown silt loam and gravelly silt loam 15 inches thick. Basalt is at a depth of 23 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Anders soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass, bluebunch wheatgrass, Idaho fescue, and stiff sagebrush. The production of forage is limited by the very low available water capacity and cobbles on the surface of the Bakeoven soil and by the moderate available water capacity of the Anders soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass, sixweeks fescue, and big sagebrush increases. Seeding generally is not practical on the Bakeoven soil because of the very low available water capacity, very cobbly surface layer, and low annual precipitation. Seeding is limited on the Anders soil by the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

20-Bakeoven-Condon complex, 0 to 25 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 12 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 125 days.

This unit is 50 percent Bakeoven very cobbly loam and 35 percent Condon silt loam. The Bakeoven soil is between mounds, and the Condon soil is on mounds. The mounds are elongated and extend downslope. They are 20 to 35 feet long, 6 to 20 feet wide, 15 to 100 feet apart, and 1 foot to 4 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent soils that are underlain by basalt at a depth of 12 to 20 inches and are between mounds. Also included is about 5 percent soils that are underlain by basalt at a depth of more than 40 inches and are on mounds and foot slopes.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Condon soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam 9 inches thick. The subsoil is brown and yellowish brown silt loam 18 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Condon soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass, bluebunch wheatgrass, Idaho fescue, and stiff sagebrush. The production of forage is limited by the very low available water capacity and cobbles on the surface of the Bakeoven soil and by the moderate available water capacity of the Condon soil. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass and bluebunch wheatgrass decreases and the proportion of

less preferred forage plants such as cheatgrass, sixweeks fescue, and big sagebrush increases. Seeding generally is not practical on the Bakeoven soil because of the very low available water capacity, very cobbly surface layer, and low annual precipitation. Seeding on the Condon soil is limited by the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

21-Bakeoven-Lickskillet-Zen complex, 5 to 25 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 1,500 to 2,700 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

This unit is 30 percent Bakeoven very cobbly loam, 25 percent Lickskillet very cobbly loam, and 20 percent Zen silt loam. The Bakeoven and Lickskillet soils are between mounds, and the Zen soil is on mounds. The mounds are elongated and extend downslope. They are 20 to 35 feet long, 6 to 20 feet wide, 15 to 100 feet apart, and 1 foot to 4 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 20 percent Renslow silt loam and Rails silt loam on mounds and foot slopes. Also included is about 5 percent soils that have a stony surface layer and are between mounds.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived from loess and in material weathered from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is brown and yellowish brown very gravelly loam 11 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of this Lickskillet soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Zen soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam 7 inches thick. The subsoil is brown and yellowish brown silt loam 17 inches thick. The substratum is yellowish brown silt loam 4 inches thick. Basalt is at a depth of 28 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Zen soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass, bluebunch wheatgrass, stiff sagebrush, and big sagebrush. The production of forage is limited by the very low available water capacity and cobbles on the surface of the Bakeoven and Lickskillet soils and by the moderate available water capacity of the Zen soil. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass, sixweeks fescue, and sagebrush increases. Seeding on the Bakeoven and Lickskillet soils is not practical because of the very low available water capacity, very cobbly surface layer, and low annual precipitation. Seeding on the Zen soil is limited mainly by the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

22-Bakeoven-Roloff complex, 0 to 25 percent slopes. This map unit is on benches and hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,200 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 145 days.

This unit is 50 percent Bakeoven very cobbly loam and 30 percent Roloff silt loam. The Bakeoven soil is between mounds, and the Roloff soil is on mounds. The mounds are 20 to 30 feet in diameter, 15 to 100 feet apart, and 1 foot to 4 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit between mounds is about 15 percent soils that are underlain by basalt at a depth of 12 to 20 inches, Strat stony loam, somewhat poorly drained soils in depressional areas, and Rock outcrop. Included on mounds is about 5 percent soils that are underlain by basalt at a depth of more than 40 inches.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Roloff soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown silt loam 11 inches thick. The subsoil is yellowish brown silt

loam 6 inches thick. The substratum is yellowish brown silt loam 12 inches thick. Basalt is at a depth of 29 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Roloff soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass, bluebunch wheatgrass, Idaho fescue, stiff sagebrush, and big sagebrush. The production of forage is limited by the very low available water capacity and cobbles on the surface of the Bakeoven soil and by the moderate available water capacity of the Roloff soil. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass, sixweeks fescue, and big sagebrush increases. Seeding on the Bakeoven soil is not practical because of the very low available water capacity, very cobbly surface layer, and low annual precipitation. Seeding on the Roloff soil is limited by the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

23-Bakeoven-Touhey complex, 0 to 25 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses and shrubs. Elevation is 1,600 to 2,600 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

This unit is 45 percent Bakeoven very cobbly loam and 30 percent Touhey very fine sandy loam. The Bakeoven soil is between mounds, and the Touhey soil is on mounds and in concave areas. The mounds are 30 to 50 feet long, 30 to 100 feet apart, and 4 to 6 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit on mounds is about 20 percent soils that have basalt at a depth of 20 to 60 inches, stony soils, and Timentwa soils. Included between mounds is about 5 percent soils that have basalt at a depth of 12 to 20 inches and Rock outcrop.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Touhey soil is very deep and well drained. It formed in glacial till overlain by a mantle of loess. Typically, the surface layer is brown very fine sandy loam 13 inches thick. The subsoil is yellowish brown gravelly very fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray gravelly fine sandy loam. Discontinuous, weakly cemented lenses of lime and silica less than 1/8 inch thick are at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the cemented lenses ranges from 20 to 36 inches.

Permeability of this Touhey soil is moderate above and below the cemented lenses and moderately slow through them. Available water capacity is moderate. Effective rooting depth is limited by the cemented lenses at a depth of 20 to 36 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass, bluebunch wheatgrass, Idaho fescue, stiff sagebrush, and big sagebrush. The production of forage is limited by the very low available water capacity and cobbles on the surface of the Bakeoven soil and by the moderate available water capacity of the Touhey soil. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass, sixweeks fescue, and big sagebrush increases. Seeding on the Bakeoven soil generally is not practical because of the very low available water capacity, very cobbly surface layer, and low annual precipitation. Seeding on the Touhey soil is limited by the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

24-Benco gravelly loam, 0 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,900 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 48 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown gravelly loam 8 inches thick. The subsoil is pale brown very gravelly loam 15 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Benco soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is-60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent soils that have a cobbly or stony surface layer.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

25-Benco stony loam, 0 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,900 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 48 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown stony loam 8 inches thick. The subsoil is pale brown very gravelly loam 15 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Benco soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent soils that have a very stony or cobbly surface layer.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are stones on the surface, the moderate available water capacity, and the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

26-Burbank loamy fine sand, 0 to 5 percent slopes. This very deep, excessively drained soil is on terraces. It formed in gravelly glacial outwash that has a mantle of eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 400 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown loamy fine sand 4 inches thick. The upper 19 inches of the underlying material is yellowish brown loamy fine sand, yellowish brown gravelly loamy fine sand, and pale brown gravelly loamy sand, and the lower part to a depth of 60 inches or more is gray extremely gravelly sand.

Permeability of this Burbank soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Quincy loamy fine sand, soils that have a weakly cemented layer at a depth of 20 to 30 inches, soils that have a surface layer of fine sand or sand, Malaga gravelly sandy loam, Ephrata fine sandy loam, and Burbank soils that have slopes of more than 5 percent.

This unit is used as rangeland, for irrigated cultivated crops, orchards, hay, and pasture, and as homesites.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing, the low annual precipitation, and the low available water capacity.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the low available water capacity. The main irrigated cultivated crops are small grain, potatoes, corn, and alfalfa. Sprinkler, drip, or trickle irrigation systems are suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of water.

Winter cover crops protect the soil from soil blowing. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Low-residue crops can be grown if the unit is adequately protected from soil blowing. Erosion in orchards is reduced by growing perennial

cover crops. To avoid exposing the extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

This unit is poorly suited to homesite development. The main limitation is the presence of gravel, which may interfere with excavation for footings. Soil blowing can be a problem on construction sites. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies. Gravel can interfere with the placement of absorption lines.

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

27-Burbank loamy fine sand, 5 to 15 percent slopes. This very deep, excessively drained soil is on outwash terraces. It formed in gravelly glacial outwash overlain by a mantle of eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 400 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown loamy fine sand 4 inches thick. The upper 19 inches of the underlying material is yellowish brown loamy fine sand, yellowish brown gravelly loamy fine sand, and pale brown gravelly loamy sand, and the lower part to a depth of 60 inches or more is gray extremely gravelly sand.

Permeability of this Burbank soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Quincy loamy fine sand, soils that have a weakly cemented layer at a depth of 20 to 30 inches, soils that have a surface layer of fine sand and sand, Malaga gravelly sandy loam, Ephrata fine sandy loam, and Burbank soils that have slopes of less than 5 percent.

This unit is used as rangeland and for irrigated crops.

The potential plant community on the Burbank soil is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding generally is not practical because of the hazard of soil blowing, low annual precipitation, and low available water capacity.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of soil blowing, and the low available water capacity. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation systems are suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of water.

Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Low-residue crops can be grown if the unit is adequately protected from soil blowing. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

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

28-Burbank very cobbly loamy sand, 0 to 15 percent slopes. This very deep, excessively drained soil is on outwash terraces. It formed in gravelly glacial outwash overlain by a mantle of eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 400 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown very cobbly loamy sand 9 inches thick. The upper 14 inches of the underlying material is yellowish brown gravelly loamy fine sand and pale brown gravelly loamy sand, and the lower part to a depth of 60 inches or more is gray extremely gravelly sand.

Permeability of this Burbank soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 25 percent soils that have a weakly cemented layer at a depth of 20 to 30 inches, Quincy loamy fine sand, soils that have a surface layer of fine sand or sand, Burbank loamy fine sand, Malaga gravelly sandy loam, and Ephrata fine sandy loam.

This unit is used as rangeland.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding generally is not practical

because of cobbles on the surface, the hazard of soil blowing, the low annual precipitation, and the low available water capacity.

This map unit is in capability subclass VIIe, nonirrigated.

29-Burbank stony loamy sand, 2 to 15 percent slopes. This very deep, excessively drained soil is on terraces. It formed in gravelly glacial outwash overlain by a mantle of eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 400 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown stony loamy sand 9 inches thick. The upper 14 inches of the underlying material is yellowish brown gravelly loamy fine sand and pale brown very gravelly loamy sand, and the lower part to a depth of 60 inches or more is gray extremely gravelly sand.

Permeability of this Burbank soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent soils that have a weakly cemented layer at a depth of 20 to 30 inches; Quincy loamy fine sand; soils that have a surface layer of fine sand or sand; soils that are gravelly, cobbly, or very stony; Malaga gravelly sandy loam; and Ephrata fine sandy loam.

This unit is used as rangeland and for irrigated cultivated crops, orchards, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding generally is not practical because of stones on the surface, the hazard of soil blowing, the low annual precipitation, and the low available water capacity.

If this unit is used for irrigated crops, the main limitations are steepness of slope, stones on the surface, the low available water capacity, and the hazard of soil blowing. The main irrigated field crop is alfalfa. Sprinkler, drip, or trickle irrigation systems are suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of water. Proper management of hay and pasture helps to control erosion. Tillage is limited on this unit because of stones on or near the surface of the soil. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclasses VIe, irrigated, and VIIe, nonirrigated.

30-Burbank very bouldery loamy sand, 0 to 10 percent slopes. This very deep, excessively drained soil is on outwash terraces. It formed in gravelly glacial outwash overlain by a mantle of eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 400 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown very bouldery loamy sand 9 inches thick. The upper 14 inches of the underlying material is yellowish brown gravelly loamy fine sand and pale brown gravelly loamy sand, and the lower part to a depth of 60 inches or more is gray extremely gravelly sand.

Permeability of this Burbank soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 25 percent soils that have a weakly cemented layer at a depth of 20 to 30 inches; Quincy loamy fine sand; soils that have a surface layer of fine sand and sand; soils that are gravelly, cobbly, or very stony; Malaga gravelly sandy loam; and Ephrata fine sandy loam.

This unit is used as rangeland.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding generally is not practical because of boulders on the surface, the low annual precipitation, and the low available water capacity.

This map unit is in capability subclass VIIe, nonirrigated.

31-Burke silt loam, 0 to 5 **percent slopes.** This well drained soil is on hillsides. It is moderately deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,200 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The substratum is pale brown silt loam 28 inches thick. A hardpan is at a depth of 34

inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Shano silt loam, soils that are severely eroded, Prosser very fine sandy loam, and soils that have basalt at a depth of less than 60 inches.

This unit is used for nonirrigated and irrigated cultivated crops and for irrigated hay and pasture.

The main limitation of this unit for nonirrigated crops is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Soil blowing is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water can be reduced by shaping waterways and seeding them to permanent cover.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and the moderate available water capacity. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation systems are used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the restricted depth to the hardpan and the moderate available water capacity, most crops need frequent applications of water.

Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer, increases the water intake rate and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

32-Burke silt loam, 5 to 15 percent slopes. This well drained soil is on hillsides. It is moderately deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,200 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The underlying material is pale brown silt loam 28 inches thick. A hardpan is at a depth of 34 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Shano silt loam, soils that are severely eroded, Prosser very fine sandy loam, and soils that have basalt at a depth of less than 60 inches.

This unit is used for nonirrigated crops and irrigated cultivated crops and for irrigated pasture and hay.

If this unit is used for nonirrigated crops, the main limitation is low annual precipitation. The unit is suited to winter wheat, which produces higher yields than does spring wheat. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Soil blowing is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing, steepness of slope, and the moderate available water capacity. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses for hay and pasture.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to the hardpan and the moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

33-Chard very fine sandy loam, 5 to 15 percent slopes. This very deep, well drained soil is on terraces.

It formed in glaciofluvial deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 48 degrees F, and the average frost-free season is about 135 days.

Typically, the surface layer is dark grayish brown and grayish brown very fine sandy loam 13 inches thick. The subsoil is brown very fine sandy loam 13 inches thick. The substratum to a depth of 60 inches or more is brown and light brownish gray fine sandy loam.

Permeability of this Chard soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent soils that have a substratum of silt loam. Also included is about 15 percent Bagdad silt loam and Chard soils that have slopes of less than 5 percent.

This unit is used for nonirrigated crops.

If this unit is used for nonirrigated crops, the main limitations are the hazard of water erosion, the low annual precipitation, and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble fields across the slope reduces runoff. Level and gradient terraces can be used on the more nearly level slopes to control runoff.

This map unit is in capability subclass IIIe, nonirrigated.

34-Cleman very fine sandy loam. This very deep, well drained soil is on alluvial plains. It formed in sandy alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 400 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown very fine sandy loam 9 inches thick. The upper 24 inches of the underlying material is brown very fine sandy loam, and the lower part to a depth of 60 inches or more is brown and pale brown loamy fine sand.

Permeability of this Cleman soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is subject to rare periods of flooding.

Included in this unit is about 15 percent Esquatzel silt loam.

This unit is used mainly for nonirrigated and irrigated cultivated crops. It is also used as rangeland, for irrigated hay and pasture, and as homesites.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation systems are used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from soil blowing. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the loamy fine sand substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation

and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is poorly suited to homesite development. The main limitation for use as homesites and for septic tank absorption fields is the hazard of flooding. Soil blowing can be a problem on construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

35-Condon silt loam, 5 to 25 percent slopes. This moderately deep, well drained soil is on hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 125 days.

Typically, the surface layer is dark grayish brown silt loam 9 inches thick. The subsoil is brown and yellowish brown silt loam 18 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Condon soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Bagdad silt loam, soils that have basalt at a depth of less than 20 inches, and Condon soils that have slopes of less than 5 percent.

This unit is used for nonirrigated crops.

If this unit is used for nonirrigated crops, the main limitations are the hazard of water erosion and low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of winter wheat is higher than that of spring wheat. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Crop residue left on the surface helps to conserve moisture, maintain tilth, and control erosion. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

This map unit is in capability subclass IVe, nonirrigated.

36-Ekrub fine sand, 0 to 25 percent slopes. This somewhat excessively drained soil is on terraces. It is shallow over a hardpan. The soil formed in eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is grayish brown fine sand 3 inches thick. The upper 9 inches of the underlying material is light grayish brown fine sand, and the lower 6 inches is light grayish brown very gravelly fine sand. A hardpan is at a depth of 18 inches. Depth to the hardpan ranges from 10 to 20 inches. The soil is calcareous throughout.

Permeability of this Ekrub soil is rapid above the hardpan and very slow through it. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

Included in this unit is about 25 percent Koehler loamy fine sand, Quincy loamy fine sand, Taunton fine sandy loam, and Schawana loamy fine sand. Also included are severely eroded soils that are less than 10 inches deep to a hardpan.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the very low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding generally is not practical because of the hazard of soil blowing, the very low available water capacity, and the low annual precipitation.

If this unit is used for irrigated hay and pasture, the main limitations are steepness of slope, the hazards of soil blowing and water erosion, and the very low available water capacity. The main crops are alfalfa and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the very low available water capacity, most crops need frequent, light applications of water. Proper management of pasture and hay helps to control erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclasses VIe, irrigated, and VIIe, nonirrigated.

37-Ellisforde silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment that has a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 9 inches thick. The subsoil is pale brown silt loam 12

inches thick. The upper 6 inches of the substratum is pale brown very fine sandy loam, and the lower part to a depth of 60 inches or more is light brownish gray and light gray silt loam. The soil is calcareous in the substratum.

Permeability of this Ellisforde soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Farrell very fine sandy loam and Ellisforde soils that have slopes of more than 5 percent.

This unit is used for nonirrigated crops, for irrigated cultivated crops, hay, and pasture, and as rangeland.

If this unit is used for nonirrigated crops, the main limitation is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of winter wheat is higher than that of spring wheat. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Level terraces also can be used to control runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. The main irrigated cultivated crops are small grain and alfalfa. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation systems are used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing and high-residue crops in the rotation reduces water erosion. Proper management of hay and pasture helps to control erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

38-Ellisforde silt loam, 5 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment that has a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 9 inches thick. The subsoil is pale brown silt loam 12 inches thick. The upper 6 inches of the substratum is pale brown very fine sandy loam, and the lower part to a depth of 60 inches or more is light brownish gray and light gray silt loam. The soil is calcareous in the substratum.

Permeability of this Ellisforde soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Farrell very fine sandy loam and eroded soils in convex areas.

This unit is used for nonirrigated crops, for irrigated cultivated crops, hay, and pasture, and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are the hazard of water erosion and the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of winter wheat is higher than that of spring wheat. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Terraces also can be used to control runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain and alfalfa.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Proper management of hay and pasture helps to control erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

39-Entiat-Rock outcrop complex, 25 to 65 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses, shrubs, and scattered trees. Elevation is 1,500 to 2,500 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

This unit is 50 percent Entiat gravelly fine sandy loam and 30 percent Rock outcrop. The Entiat soil is in concave and smooth areas, and Rock outcrop is in convex areas. The components of this unit are so intricately intermingled that is was not practical to map them separately at the scale used.

Included in this unit is about 20 percent soils that have decomposing granodiorite at a depth of less than 14 inches or more than 40 inches and soils that have a stony or very stony surface layer.

The Entiat soil is shallow and well drained. It formed in loess and in material weathered from granodiorite. Typically, the surface layer is dark grayish brown and brown gravelly fine sandy loam 9 inches thick. The subsoil is brown very gravelly sandy loam. Decomposing granodiorite is at a depth of 15 inches. Depth to granodiorite or granite ranges from 14 to 20 inches.

Permeability of this Entiat soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 14 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of areas of exposed granodiorite.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the very low available water capacity, the areas of Rock outcrop, and steepness of slope. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Seeding generally is not practical because of the areas of Rock outcrop, the very low available water capacity, steepness of slope, and low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

40-Ephrata fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. Elevation is 500 to 1,300 feet. The native vegetation is mainly grasses and shrubs. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is light brownish gray fine sandy loam 9 inches thick. The subsoil is pale brown gravelly fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Malaga gravelly sandy loam. Also included are small areas of Ephrata soils that have slopes of more than 2 percent and a few areas of soils that have a surface layer and subsoil of very fine sandy loam.

This unit is used for irrigated cultivated crops, hay, and pasture and as homesites.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the moderate available water capacity. Many kinds of cultivated crops, such as sugar beets, potatoes, corn, beans, peas, alfalfa, and small grain, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate

to high, community sewage systems are needed to prevent contamination of nearby water supplies.

This map unit is in capability subclass IIe, irrigated.

41-Ephrata fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is light brownish gray fine sandy loam 9 inches thick. The subsoil is pale brown gravelly fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in, the substratum.

Permeability of this Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Malaga gravelly sandy loam, Malaga cobbly sandy loam, and Ephrata soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture and as homesites.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies.

This map unit is in capability subclass IIe, irrigated.

42-Ephrata fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is light brownish gray fine sandy loam 9 inches thick. The subsoil is pale brown gravelly fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 15 percent Malaga gravelly sandy loam, Malaga cobbly sandy loam, and Ephrata soils that have slopes of more than 10 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland, irrigated pasture, and homesites.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion and steepness of slope. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation. Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation.

Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies.

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

43-Ephrata gravelly sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is light brownish gray gravelly sandy loam 9 inches thick. The subsoil is pale brown gravelly sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Malaga gravelly sandy loam, Malaga cobbly sandy loam, Malaga stony sandy loam, and Ephrata soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture and as rangeland.

If this unit is used for irrigated crops, the main limitation is the moderate available water capacity. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

44-Ephrata gravelly sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is light brownish gray gravelly sandy loam 9 inches thick. The subsoil is pale brown gravelly sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Malaga gravelly sandy loam, Malaga cobbly sandy loam, Malaga stony sandy loam, and Ephrata soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture and as rangeland.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and the moderate available water capacity. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

45-Ephrata-Malaga complex, 0 to 5 percent slopes. This map unit is on terraces. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 45 percent Ephrata gravelly sandy loam and 40 percent Malaga cobbly sandy loam. The Ephrata soil is on mounds, and the Malaga soil is between mounds. The mounds are 20 to 30 feet in diameter, 6 to 30 feet apart, the 1/2 foot to 2 feet high. They have been leveled in cultivated areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent Malaga gravelly sandy loam on mounds. Also included is about 5 percent Malaga stony sandy loam and Malaga very cobbly sandy loam between mounds.

The Ephrata soil is very deep and well drained. It formed in gravelly glacial outwash that is mixed with loess in the upper part. Typically, the surface layer is light brownish gray gravelly sandy loam 9 inches thick. The subsoil is pale brown gravelly sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of the Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

The Malaga soil is very deep and somewhat excessively drained. It formed in glacial outwash. Typically, the surface layer is brown cobbly sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of the Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as rangeland, for irrigated cultivated crops, hay, and pasture, and as homesites.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the low available water capacity of the Malaga soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are cobbles on the surface of the Malaga soil, the restricted available water capacity, and low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are cobbles on the surface of the Malaga soil and the restricted water capacity. The main irrigated crops are alfalfa, grasses, and small grain. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the restricted available water capacity, most crops need frequent, light applications of water. Tillage is limited by cobbles on the surface of the Malaga soil. Proper management of hay and pasture helps to control erosion. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

This unit is poorly suited to homesite development. The main limitation is cobbles on the surface of the Malaga soil, which may interfere with the ease of excavation for footings. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies. Cobbles on the Malaga soil can interfere with the placement of absorption lines.

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

46-Ephrata-Malaga complex, 5 to 15 percent slopes. This map unit is on terraces. The native

vegetation is mainly grasses and shrubs. Elevation is 1,100 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 40 percent Ephrata gravelly sandy loam and 35 percent Malaga cobbly sandy loam. The Ephrata soil is on mounds, and the Malaga soil is between mounds. The mounds are 20 to 30 feet in diameter, 6 to 30 feet apart, and 1/2 foot to 2 feet high. They have been leveled in cultivated areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 15 percent Malaga gravelly sandy loam on mounds. Also included is about 10 percent Malaga stony sandy loam and Malaga cobbly sandy loam between mounds.

The Ephrata soil is very deep and well drained. It formed in gravelly glacial outwash that is mixed with loess in the upper part. Typically, the surface layer is light brownish gray gravelly sandy loam 9 inches thick. The subsoil is pale brown gravelly sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is pale brown very gravelly sandy loam and gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of the Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

The Malaga soil is very deep and somewhat excessively drained. It formed in gravelly glacial outwash that is mixed with loess in the upper part. Typically, the surface layer is brown cobbly sandy loam 6 inches thick. The upper part of the subsoil is pale brown gravelly sandy loam 5 inches thick, and the lower part is pale brown gravelly sandy loam 7 inches thick. The substratum to a depth of 60 inches or more is dark gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of the Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the low available water capacity of the Malaga soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are cobbles on the surface and the low available water capacity of the Malaga soil and the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, cobbles on the surface of the Malaga soil, and the restricted available water capacity. The main irrigated crops are alfalfa, grasses, and small grain. Because of the cobbles on the surface of the Malaga soil and steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of restricted water capacity, most crops need frequent, light applications of water. Tillage is limited by the cobbles on or near the surface of the Malaga soil. To avoid exposing the extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

47-Esquatzel silt loam. This very deep, well drained soil is on alluvial plains. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown silt loam 7 inches thick. The upper part of the underlying material is brown silt loam 45 inches thick, and the lower part to a depth of 60 inches or more is brown very fine sandy loam. The soil is calcareous in the underlying material.

Permeability of this Esquatzel soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding in March through April. The soil is subject to streambank erosion.

Included in this unit is about 25 percent Cleman very fine sandy loam and somewhat poorly drained soils.

This unit is used mainly for irrigated cultivated crops, hay, and pasture, as homesites, and for nonirrigated crops. It is also used as rangeland.

This unit is well suited to irrigated crops. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation systems are used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the

size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer and also increases the water intake rate.

If this unit is used for nonirrigated crops, the main limitation is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be managed carefully to control erosion. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

The potential plant community on this unit is mainly basin wildrye, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is poorly suited to homesite development. The main limitation for use as homesites and for septic tank absorption fields is the hazard of flooding. Dustiness can be a problem on large construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

This map unit is in capability class I, irrigated, and subclass IIIc, nonirrigated.

48-Farrell very fine sandy loam, 0 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in glaciofluvial deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown very fine sandy loam 8 inches thick. The subsoil is brown very fine sandy loam 12 inches thick. The upper 20 inches of the substratum is light brownish gray fine sandy loam, and the lower part to a depth of 60 inches or more is pale brown silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Farrell soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 10 percent Ellisforde silt loam, Magallon sandy loam, and soils that have a loamy fine sand surface layer. Also included is about 25 percent soils that are calcareous at a depth of more than 40 inches.

This unit is used for nonirrigated crops, as rangeland, and for irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion. The main irrigated crops are small grain and alfalfa.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation systems are used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion and soil blowing. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

49-Farrell very fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in glaciofluvial deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown very fine sandy loam 8 inches thick. The subsoil is brown very fine sandy loam 12 inches thick. The upper 20 inches of the substratum is light brownish gray fine sandy loam, and the lower part to a depth of 60 inches or more is pale brown silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Farrell soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 10 percent Ellisforde silt loam, Magallon sandy loam, and soils that have a loamy fine sand surface layer. Also included is about 25 percent soils that are calcareous at a depth of more than 40 inches.

This unit is used for nonirrigated crops, for irrigated cultivated crops, hay, and pasture, and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing and water erosion are reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing. Chiseling or subsoiling the stubble field across the slope reduces runoff.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. The main irrigated cultivated crops are small grain and alfalfa.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

50-Finley gravelly fine sandy loam, 0 to 15 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in gravelly alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,500 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown gravelly fine sandy loam 8 inches thick. The subsoil is brown very gravelly sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray extremely gravelly loamy sand. The soil is calcareous in the substratum.

Permeability of this Finley soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Included in this unit is about 25 percent Finley soils that are calcareous at a depth of less than 14 inches. Also included is about 5 percent soils that are cobbly or stony.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush,

rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and low available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion, steepness of slope, and the low available water capacity. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing, crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the low available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the extremely gravelly loamy sand, land smoothing operations that include only shallow cuts are advisable.

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

51-Finley very cobbly fine sandy loam, 0 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in gravelly alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,500 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very cobbly fine sandy loam 8 inches thick. The subsoil is brown extremely cobbly fine sandy loam and very cobbly sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray very cobbly loamy sand and extremely cobbly loamy sand. The soil is calcareous in the substratum.

Permeability of this Finley soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 25 percent Finley soils that are calcareous at a depth of less than 14 inches. Also included is about 5 percent soils that are stony or gravelly and soils that are subject to rare periods of flooding.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of cobbles on the surface, the low available water capacity, and the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

52-Finley-Taunton complex, 0 to 5 percent slopes. This map unit is on alluvial fans. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,500 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 40 percent Finley very fine sandy loam and 35 percent Taunton silt loam. The Finley soil is in concave and smooth areas along drainageways, and the Taunton soil is in convex and smooth areas between drainageways. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent Scoon silt loam, Finley very cobbly fine sandy loam, Finley gravelly fine sandy loam, Taunton loamy fine sand, and Finley soils that have slopes of more than 5 percent.

The Finley soil is very deep and well drained. It formed in gravelly alluvium. Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is brown very gravelly sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray extremely gravelly loamy sand. The soil is calcareous in the substratum.

Permeability of the Finley soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding.

The Taunton soil is well drained. It is moderately deep over a hardpan. The soil formed in loess and alluvium. Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown silt loam and gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as rangeland and for irrigated cultivated crops, orchards, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity and the hazard of soil blowing on the Finley soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the hazard of soil blowing on the Finley soil, the low annual precipitation, and the restricted available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and the hazard of soil blowing and low available water capacity on the Finley soil. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, corn, alfalfa, beans, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the low available water capacity of the Finley soil, most crops need frequent applications of water. Returning crop residue to the soil and chiseling, when needed, increases the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the very gravelly material in the Finley soil and the hardpan in the Taunton soil, land smoothing operations that include only shallow cuts are advisable.

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

53-Finley-Taunton complex, 5 to 10 percent slopes. This map unit is on alluvial fans. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,500 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 40 percent Finley very fine sandy loam and 35 percent Taunton silt loam. The Finley soil is in concave and smooth areas along drainageways, and the Taunton soil is in convex and smooth areas between drainageways. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent Scoon silt loam, Finley very cobbly fine sandy loam, Finley gravelly fine sandy loam, Taunton loamy fine sand, and Finley and Taunton soils that have slopes of more than 10 percent.

The Finley soil is very deep and well drained. It formed in gravelly alluvium. Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is brown very gravelly sandy loam 13 inches thick. The substratum to a depth of 60 inches or more is light brownish gray extremely gravelly loamy sand. The soil is calcareous in the substratum.

Permeability of the Finley soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate. This soil is subject to rare periods of flooding.

The Taunton soil is well drained. It is moderately deep over a hardpan. The soil formed in loess and alluvium. Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown silt loam and gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for irrigated cultivated crops, orchards, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity and the hazard of soil blowing on the Finley soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation

and the low available water capacity and hazard of soil blowing on the Finley soil. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of water erosion, and the low available water capacity and hazard of soil blowing on the Finley soil. Many kinds of cultivated crops, such as small grain, sugar beets, potatoes, corn, alfalfa, beans, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the low available water capacity of the Finley soil, most crops need frequent applications of water. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Erosion in orchards is reduced by growing perennial cover crops. To avoid exposing the very gravelly material in the Finley soil and the hardpan in the Taunton soil, land smoothing operations that include only shallow cuts are advisable.

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

54-Hermiston silt loam. This very deep, well drained soil is on alluvial plains. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,600 to 2,300 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 130 days.

Typically, the surface layer is grayish brown and brown silt loam 21 inches thick. The underlying material to a depth of 60 inches or more is brown and pale brown silt loam. The soil is calcareous in the underlying material.

Permeability of this Hermiston soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to occasional periods of flooding in January through April.

Included in this unit is about 25 percent Pedigo silt loam and soils that have basalt at a depth of less than 60 inches.

This unit is used for nonirrigated crops.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the occasional periods of flooding. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff.

This map unit is in capability subclass IIw, nonirrigated.

55-Hezel loamy fine sand, 0 to 10 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in lacustrine sediment that has a mantle of eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,500 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is grayish brown loamy fine sand 8 inches thick. The upper 18 inches of the substratum is grayish brown loamy fine sand and brown loamy sand, and the lower part to a depth of 60 inches or more is light brownish gray and pale brown silt loam. The soil is calcareous in the lower part of the substratum.

Permeability of this Hezel soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Quincy loamy fine sand, Kennewick loamy fine sand, Royal loamy fine sand, Sagehill very fine sandy loam, and Royal very fine sandy loam.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of soil blowing, and droughtiness. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the sandy texture of the surface layer, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the lower part of the substratum, which is calcareous.

The potential plant community on this unit is mainly needleandthread, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the sandy texture of the surface layer. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as

rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing and low annual precipitation.

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

56-Kennewick loamy fine sand, 0 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface. layer is very pale brown loamy fine sand 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam that includes fine layers of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting' depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Hezel loamy fine sand, Kennewick silt loam, soils that have a hardpan at a depth of 40 to 60 inches, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the sandy surface layer. If the range is overgrazed, the proportion of preferred forage punts such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing and low annual precipitation.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and the sandy texture of the surface layer. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the sandy texture of the surface layer, most crops need frequent applications of water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

57-Kennewick loamy fine sand, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown loamy fine sand 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam that includes fine layers of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent Hezel loamy fine sand, Kennewick silt loam, soils that have a hardpan at a depth of 40 to 60 inches, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the sandy texture of the surface layer. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing and low annual precipitation.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazards of soil blowing and water erosion, and the sandy texture surface of the layer. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the sandy texture of the surface layer, most crops need frequent applications of water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover

crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

58-Kennewick fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown fine sandy loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam that includes fine layers of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Kennewick loamy fine sand, Sagehill very fine sandy loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 2 percent, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable. Also included is about 10 percent Kennewick silt loam and Warden silt loam.

This unit is used as rangeland, for irrigated cultivated crops, hay, and pasture, and as homesites.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

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

59-Kennewick fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown fine sandy loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam that includes fine layers of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Kennewick loamy fine sand, Sagehill very fine sandy loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 5 percent, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable. Also included is about 10 percent Kennewick silt loam and Warden silt loam.

This unit is used for irrigated cultivated crops, rangeland, irrigated hay and pasture, and homesites.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to

this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

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

60-Kennewick fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown fine sandy loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam that includes fine layers of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 15 percent Kennewick loamy fine sand, Sagehill very fine sandy loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 10 percent, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable. Also included is about 10 percent Kennewick silt loam and Warden silt loam.

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

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Minimum tillage, which helps to maintain the tilth of the surface layer, increases water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

61-Kennewick fine sandy loam, 10 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches,

the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown fine sandy loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam that includes fine layers of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

Included in this unit is about 15 percent Kennewick loamy fine sand, Sagehill very fine sandy loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 15 percent, and soils adjacent to Royal city that do not have a stratified substratum and are moderately permeable. Also included is about 10 percent Kennewick silt loam and Warden silt loam.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the slope. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

62-Kennewick silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown silt loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam and fine strata of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Kennewick fine sandy loam, Wahluke very fine sandy loam, Warden silt loam, Sagemoor silt loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 2 percent, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly winterfat, Sandberg bluegrass, and spiny hopsage. If the range is overgrazed, the proportion of preferred forage plants such as winterfat and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as spiny hopsage and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

63-Kennewick silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown silt loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam and fine strata of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Kennewick fine sandy loam, Wahluke very fine sandy loam, Warden silt loam, Sagemoor silt loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 5 percent, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable.

This unit is used for irrigated cultivated crops, rangeland, irrigated hay and pasture, and homesites.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly winterfat, Sandberg bluegrass, and spiny hopsage. If the range is overgrazed, the proportion of preferred forage plants such as winterfat and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as spiny hopsage and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development. Dustiness can be a problem on construction sites; therefore, these sites should be disturbed as little as possible. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

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

64-Kennewick silt loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown silt loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam and fine strata of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Kennewick fine sandy loam, Wahluke very fine sandy loam, Warden silt loam, Sagemoor silt loam, soils that have a hardpan at a depth of 20 to 60 inches, Kennewick soils that have slopes of more than 10 percent, and soils adjacent to Royal City that do not have a stratified substratum and are moderately permeable.

This unit is used for irrigated cultivated crops, hay, and pasture and as homesites and rangeland.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When

growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

The potential plant community on this unit is mainly winterfat, Sandberg bluegrass, and spiny hopsage. If the range is overgrazed, the proportion of preferred forage plants such as winterfat, Sandberg bluegrass, and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as spiny hopsage, cheatgrass, and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. .Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development. Dustiness can be a problem on large construction sites; therefore, these sites should be disturbed as little as possible. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

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

65-Kennewick silt loam, 10 to 25 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is very pale brown silt loam 9 inches thick. The substratum to a depth of 60 inches or more is very pale brown silt loam and fine strata of silt. The soil is calcareous throughout.

Permeability of this Kennewick soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Kennewick fine sandy loam, Wahluke very fine sandy loam, Warden silt loam, Sagemoor silt loam, soils that have a hardpan at a depth of 20 to 60 inches, and Kennewick soils that have slopes of less than 10 percent.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly winterfat, Sandberg bluegrass, and spiny hopsage. If the range is overgrazed, the proportion of preferred forage plants such as winterfat and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as spiny hopsage and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazards of water erosion and soil blowing. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as alfalfa, grasses, and small grain.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid' excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

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

66-Kiona cobbly very fine sandy loam, 25 to 65 percent slopes. This very deep, well drained soil is on hillsides. It formed in colluvium derived from loess and basalt. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,500 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is brown cobbly very fine sandy loam 3 inches thick. The subsoil is brown cobbly very fine sandy loam 16 inches thick. The substratum to a depth of 60 inches or more is brown very cobbly sandy loam. The soil is calcareous in the substratum.

Permeability of this Kiona soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 15 percent Finley very cobbly fine sandy loam, soils that have basalt at a depth less than 40 inches, and Rock outcrop.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases.

Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of the steepness of slope, cobbles on the surface, and low annual precipitation.

This map unit is in capability subclass VIIe, nonirrigated.

67-Kiona-Rock outcrop complex, 25 to 65 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,500 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

This unit is 50 percent Kiona stony very fine sandy loam and 30 percent Rock outcrop. The Kiona soil is on hillsides, and Rock outcrop is on midslopes and shoulders of hillsides. Some areas of Rock outcrop are nearly perpendicular cliffs, The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 10 percent soils that have a very stony or cobbly surface layer and 5 percent soils that have basalt at a depth of less than 40 inches. Also included is about 5 percent Rubble land.

The Kiona soil is very deep and well drained. It formed in colluvium derived from loess and basalt. Typically, the surface layer is brown stony very fine sandy loam 3 inches thick. The subsoil is brown cobbly very fine sandy loam 16 inches thick. The substratum to a depth of 60 inches or more is very cobbly sandy loam. The soil is calcareous in the substratum.

Permeability of this Kiona soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of exposed areas of basalt.

This unit is used as rangeland.

The potential plant community on the Kiona soil is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the areas of Rock outcrop and moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases.

Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of the steepness of slope, areas of Rock outcrop, stones on the surface, low annual precipitation, and moderate available water capacity.

This map unit is in capability subclass VIIs, nonirrigated.

68-Kittitas silt loam. This very deep, somewhat poorly drained, salt- and sodium-affected soil is on alluvial plains. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is grayish brown silt loam 20 inches thick. The upper 22 inches of the substratum is light brownish gray silt loam and very fine sandy loam, the next 10 inches is grayish brown silty clay loam, and the lower part to a depth of 60 inches or more is light brownish gray very fine sandy loam. This soil is calcareous throughout.

Permeability of this Kittitas soil is moderately slow. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 6 to 24 inches in January through June. This soil is subject to frequent periods of flooding in January through April. Runoff is ponded, and water erosion is not a hazard. The hazard of soil blowing is moderate.

Included in this unit is about 15 percent Umapine silt loam and Esquatzel silt loam.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly sedge, rush, inland saltgrass, and bluegrass. The production of forage is limited by excess salts. If the range is overgrazed, the proportion of preferred forage plants such as bluegrass decreases and the proportion of less preferred forage plants such as sedge, rush, and inland saltgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are excess salts and wetness. Among the grasses that are suitable for seeding are tall wheatgrass and other salt-tolerant grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing, wetness, excess salts, and the hazard of flooding. Salinity

influences the choice of crops. If the soil in this unit is drained, leached of excess salts, and irrigated, it is suited to small grain, sugar beets, corn, alfalfa, and grasses.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

The addition of soil amendments such as gypsum, sulfur, or sulfuric acid should be based on soil tests. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil.

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

69-Koehier loamy fine sand, 0 to 10 percent slopes. This somewhat excessively drained soil is on terraces. It is moderately deep over a hardpan. The soil formed in eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,200 feet.' The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very pale brown loamy fine sand 3 inches thick. The upper 17 inches of the substratum is very pale brown loamy fine sand, and the lower 13 inches is very pale brown very gravelly fine sand. A hardpan is at a depth of 33 inches. This soil is calcareous throughout. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Koehler soil is rapid above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent Ekrub fine sand, Quincy loamy fine sand, Taunton fine sandy loam, Sagehill very fine sandy loam, Royal very fine sandy loam, Schawana cobbly loamy fine sand, and Koehler soils that have slopes of more than 10 percent.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, bluebunch wheatgrass, antelope bitterbrush, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing, the low available water capacity, and the low annual precipitation.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazards of soil blowing and water erosion, and the low available water capacity. The main irrigated crops are small grain, alfalfa, and grasses. Tillage is limited because of rock fragments on or near the surface of the soil.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope, depth to the hardpan, and sandy texture. Because of the depth to the hardpan and low available water capacity, most crops need frequent, light applications of water. Using alfalfa and grasses in the rotation reduces erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

70-Lickskillet very cobbly loam, 35 to 65 percent slopes. This shallow, well drained soil is on hillsides. It formed in colluvium derived from loess and basalt. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is brown and yellowish brown very gravelly loam 11 inches thick. Basalt is at a depth of 15 inches. Depth to bedrock ranges from 12 to 20 inches.

Permeability of this Lickskillet soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very high.

Included in this unit is about 25 percent Bakeoven very cobbly loam and soils, on foot slopes, that have basalt at a depth of more than 40 inches. Also included is about 5 percent soils that have a stony surface layer.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the very low available water capacity. If the

range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of the steepness of slope, cobbles on the surface, and very low available water capacity.

This map unit is in capability subclass VIIs, nonirrigated.

71-Magallon sandy loam, 0 to 5 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,700 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is grayish brown sandy loam 8 inches thick. The subsoil is brown sandy loam 15 inches thick. The upper 9 inches of the substratum is brown loamy sand, and the lower part to a depth of 60 inches or more is dark gray coarse sand.

Permeability of this Magallon soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Stratford loam. Also included is about 5 percent Farrell very fine sandy loam and Magallon soils that have slopes of more than 5 percent.

This unit is used for nonirrigated crops, rangeland, and irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, the hazard of soil blowing, and the moderate available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, the moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the moderate available water capacity. The main irrigated crops are small grain, alfalfa, and grasses. Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. Corrugation irrigation is suited to close-growing crops. Because of the moderate available water capacity, most crops need frequent, light applications of water. Using alfalfa and grasses in the rotation reduces erosion. To avoid exposing coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

72-Magallon sandy loam, 5 to 10 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 1,700 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is grayish brown sandy loam 8 inches thick. The subsoil is brown sandy loam 15 inches thick. The upper 9 inches of the substratum is brown loamy sand, and the lower part to a depth of 60 inches or more is dark gray coarse sand.

Permeability of this Magallon soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent Stratford loam. Also included is about 5 percent Farrell very fine sandy loam, Quincy loamy fine sand, and Magallon soils that have slopes of more than 10 percent.

This unit is used for nonirrigated crops, rangeland, and irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, the hazard of soil blowing, and the moderate available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Soil blowing is reduced if fall grain is seeded early, rows are at right angles to the prevailing wind, and stubble mulch tillage is used.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, the moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing, steepness of slope, and moderate available water capacity. The main irrigated crops are small grain, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit because of the steepness of slope. Because of the moderate available water capacity, most crops need frequent, light applications of irrigation water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

73-Malaga gravelly sandy loam, 0 to 5 percent slopes. This very deep, somewhat excessively drained soil is on terraces and terrace escarpments. It formed in glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown gravelly sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Malaga cobbly sandy loam, Malaga stony sandy loam, Ephrata gravelly sandy loam, and Malaga soils that have slopes of more than 5 percent. Also included is about 5 percent soils that have a surface layer of very fine sandy loam and have sand and gravelly material at a depth of 28 to 60 inches.

This unit is used as rangeland, for irrigated cultivated crops, hay, and pasture, and as homesites.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and the low available water capacity. The main irrigated crops are small grain, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of gravel and cobbles on the surface and the depth to extremely gravelly coarse sand. Because of the low available water capacity, most crops need frequent, light applications of irrigation water. Tillage is limited by the gravel and cobbles on or near the surface of the soil. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and low available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is poorly suited to homesite development. The main limitation for use as homesites is the presence of gravel, which may interfere with excavation for footings. Construction sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies. Gravel can interfere with the placement of absorption lines.

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

74-Malaga gravelly sandy loam, 5 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces and terrace escarpments. It formed in glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average

annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown gravelly sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Malaga cobbly sandy loam, Malaga stony sandy loam, Ephrata gravelly sandy loam, and Malaga soils that have slopes of more than 15 percent.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and low available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion, steepness of slope, and the low available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the low available water capacity, most crops need frequent, light applications of irrigation water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

75-Malaga cobbly sandy loam, 0 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces and terrace escarpments. It formed in glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown cobbly sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Malaga stony sandy loam, Malaga gravelly sandy loam, and soils southeast of Soap Lake that have a surface layer of very fine sandy loam and have sandy and gravelly material at a depth of 28 to 60 inches.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture and as homesites.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are cobbles on the surface, the low annual precipitation, and the low available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, cobbles on the surface, the low available water capacity, and the hazard of water erosion. The main irrigated crops are alfalfa and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the cobbles on the surface. Because of the low available water capacity, most crops need frequent, light applications of irrigation water. Tillage is limited by the cobbles on or near the surface of the soil. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

This unit is poorly suited to homesite development. The main limitations for use as homesites are steepness of slope and the presence of cobbles and pebbles.

Special design of buildings is needed to overcome the limitation of steepness of slope, and the cobbles and pebbles may interfere with excavation for footings. Construction sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community systems are needed to prevent contamination of nearby water supplies. Cobbles and pebbles can interfere with the placement of absorption lines.

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

76-Malaga cobbly sandy loam, 15 to 35 percent slopes. This very deep, somewhat excessively drained soil is on terraces and terrace escarpments. It formed in glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown cobbly sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Malaga stony sandy loam, Malaga gravelly sandy loam, and soils that have a surface layer of very fine sandy loam and have sandy and gravelly material at a depth of 28 to 60 inches.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the cobbles on the surface, low available water capacity, and low annual precipitation.

This map unit is in capability subclass Vle, nonirrigated.

77-Malaga stony sandy loam, 0 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown stony sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 25 percent Malaga cobbly sandy loam, Malaga very stony sandy loam, Malaga gravelly sandy loam, and soils southeast of Soap Lake that have a very fine sandy loam surface layer and subsoil and have sandy and gravelly material at a depth of 28 to 60 inches.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture and as homesites.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, low available water capacity, and stones on the surface. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, stones on the surface, and the low available water capacity. The main irrigated crops are alfalfa and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the stones on the surface. Because of the low available water capacity, most crops need frequent, light applications of irrigation water. Tillage is limited by the stones on or near the surface of the soil. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

This unit is poorly suited to homesite development. The main limitations for use as homesites are steepness of slope and the presence of stones and cobbles, which may interfere with excavation for footings. Construction sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies. Stones and cobbles can interfere with the placement of absorption lines.

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

78-Malaga very stony sandy loam, 0 to 35 percent slopes. This very deep, somewhat excessively drained soil is on terraces and terrace escarpments. It formed in glacial outwash. The native vegetation is mainly grasses and shrubs. Elevation is 450 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown very stony loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown very gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of this Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Malaga stony sandy loam, soils that have a surface layer of bouldery sandy loam, and soils southeast of Soap Lake that have a surface layer and subsoil of very fine sandy loam and have sandy and gravelly material at a depth of 28 to 60 inches.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the very stony surface layer.

This map unit is in capability subclass VIIs, nonirrigated.

79-Malaga-Ephrata complex, 0 to 15 percent slopes. This map unit is on terraces. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 40 percent Malaga very cobbly sandy loam, 0 to 15 percent slopes, and 35 percent Ephrata gravelly sandy loam, 2 to 5 percent slopes. The Malaga soil is between mounds, and the Ephrata soil is on mounds. The mounds are 20 to 30 feet in diameter, 15 to 100 feet apart, and 1 foot to 3 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit, between mounds, is about 10 percent soils that have a stony, cobbly, or very stony surface layer and about 10 percent soils that have sandy and gravelly material at a depth of 12 to 15 inches. Also included, on mounds, is about 5 percent soils that are more than 40 inches deep to sandy and gravelly material.

The Malaga soil is very deep and somewhat excessively drained. It formed in glacial outwash. Typically, the surface layer is brown very cobbly sandy loam 6 inches thick. The upper 5 inches of the subsoil is pale brown gravelly sandy loam, and the lower 7 inches is pale brown gravelly sandy loam. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of the Malaga soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

The Ephrata soil is very deep and well drained. It formed in glacial outwash. Typically, the surface layer is light brownish gray gravelly sandy loam 9 inches thick. The subsoil is pale brown gravelly fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray extremely gravelly coarse sand. The soil is calcareous in the substratum.

Permeability of the Ephrata soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as rangeland.

If the range is in good or excellent condition, the native vegetation on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass and Thurber needlegrass. The production of forage is limited by the low available water capacity of the Malaga soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less

preferred forage plants such as rabbitbrush, big sagebrush, and cheatgrass increases.

Seeding on this unit generally is not practical because of the very cobbly surface layer.

This map unit is in capability subclass VIIs, nonirrigated.

80-Neppel fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown fine sandy loam 7 inches thick. The subsoil is pale brown very fine sandy loam 9 inches thick. The upper 11 inches of the substratum is light brownish gray very fine sandy loam, the next 4 inches is light brownish gray gravelly fine sandy loam, and the lower part to a depth of 60 inches or more is light gray extremely gravelly sand. The soil is calcareous in the substratum.

Permeability of this Neppel soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent Neppel very fine sandy loam, Ephrata fine sandy loam, soils that have a hardpan at a depth of 10 to 60 inches, Roloff silt loam, and Neppel soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. Because of the moderate available water capacity, most crops need frequent applications of irrigation water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these cover crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIIe, irrigated.

81-Neppel fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown fine sandy loam 7 inches thick. The subsoil is pale brown very fine sandy loam 9 inches thick. The upper 11 inches of the substratum is light brownish gray very fine sandy loam, the next 4 inches is light brownish gray gravelly fine sandy loam, and the lower part to a depth of 60 inches or more is light gray extremely gravelly sand. The soil is calcareous in the substratum.

Permeability of this Neppel soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Neppel very fine sandy loam, Ephrata fine sandy loam, soils in convex areas that have sandy and gravelly material at a depth of 15 to 20 inches, soils that have a hardpan at a depth of 20 to 60 inches, Royal very fine sandy loam, and Neppel soils that have slopes of more than 5 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. Corrugation irrigation is suited to close-growing crops. Because of the moderate available water capacity, most crops need frequent applications of irrigation water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants

such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

82-Neppel very fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown very fine sandy loam 7 inches thick. The subsoil is pale brown very fine sandy loam 9 inches thick. The upper 11 inches of the substratum is light brownish gray very fine sandy loam, the next 4 inches is light brownish gray gravelly fine sandy loam, and the lower part to a depth of 60 inches or more is light gray extremely gravelly sand. The soil is calcareous in the substratum.

Permeability of this Neppel soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent soils that have sandy and gravelly material at a depth of 15 to 20 inches. Also included is about 15 percent Ephrata fine sandy loam, soils that have a hardpan at a depth of 20 to 60 inches, Sagehill very fine sandy loam, Royal very fine sandy loam, and Neppel soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the moderate available water capacity, most crops need frequent applications of irrigation water. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIIe, irrigated.

83-Neppel very fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown very fine sandy loam 7 inches thick. The subsoil is pale brown very fine sandy loam 9 inches thick. The upper 11 inches of the substratum is light brownish gray very fine sandy loam, the next 4 inches is light brownish gray gravelly fine sandy loam, and the lower part to a depth of 60 inches or more is light gray extremely gravelly sand. The soil is calcareous in the substratum.

Permeability of this Neppel soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent soils in convex areas that have sandy and gravelly material at a depth of 15 to 20 inches. Also included is about 15 percent Ephrata fine sandy loam, soils that have a hardpan at a depth of 20 to 60 inches, Sagehill very fine sandy loam, Royal very fine sandy loam, and Neppel soils that have slopes of more than 5 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland, for irrigated hay and pasture, and as homesites.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets,

potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the moderate available water capacity, most crops need frequent applications of irrigation water. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies.

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

84-Neppel very fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on hummocky terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown very fine sandy loam 7 inches thick. The subsoil is pale brown very fine sandy loam 9 inches thick. The upper 11 inches of the substratum is light brownish gray very fine sandy loam, the next 4 inches is light brownish gray gravelly fine sandy loam, and the lower part to a depth of 60 inches or more is light gray extremely gravelly sand. The soil is calcareous in the substratum (fig. 6).

Permeability of this Neppel soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent soils in convex areas that have sandy and gravelly material at a depth of 15 to 20 inches. Also included is about 15 percent Ephrata fine sandy loam, soils that have a hardpan at a depth of 20 to 40 inches, Sagehill very fine sandy loam, Royal very fine sandy loam, and soils that have a stony or cobbly surface layer.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing, steepness of slope, and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the moderate available water capacity, most crops need frequent applications of irrigation water. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil increases the water intake rate. Minimum tillage also increases the water intake rate and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing extremely gravelly sand, land smoothing operations that include only shallow cuts are advisable.

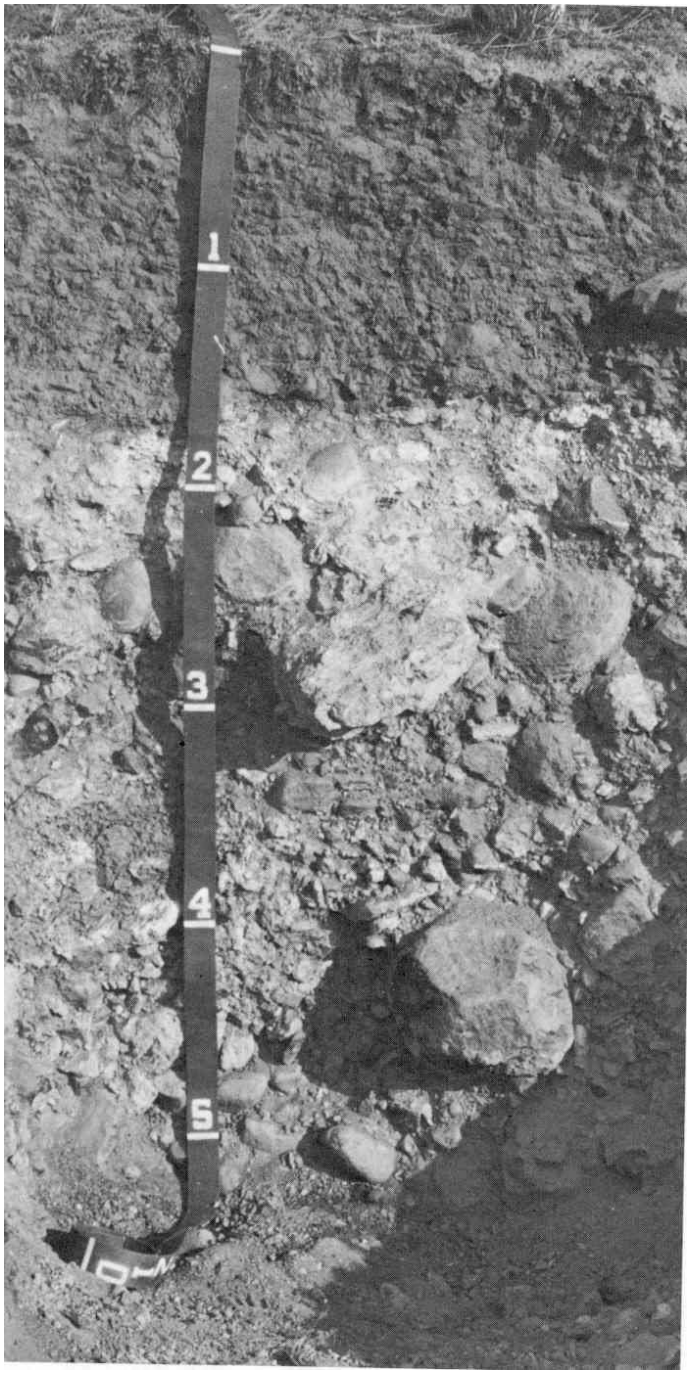

Figure 6.-Profile of Neppel very fine sandy loam, 5 to 10 percent slopes.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

85-Novark silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in a mantle of loess overlying sandy glacial outwash and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 900 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is light brownish gray silt loam 5 inches thick. The subsoil is pale brown silt loam 7 inches thick. The upper 18 inches of the substratum is light gray and white silt loam, and the lower part to a depth of 60 inches or more is very dark gray and white fine sand. The soil is calcareous in the substratum.

Permeability of this Novark soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 25 percent Warden silt loam, Sagehill very fine sandy loam, Royal very fine sandy loam, Timmerman coarse sandy loam, and Novark soils that have slopes of less than 2 percent or more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-

residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing sand, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIe, irrigated.

86-Outlook very fine sandy loam. This very deep, moderately well drained, salt- and sodium-affected soil is on alluvial plains. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,000 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown very fine sandy loam 10 inches thick. The substratum to a depth of 60 inches or more is brown silt loam that has dark yellowish brown mottles. This soil is calcareous throughout.

Permeability of this Outlook soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that fluctuates between depths of 24 and 40 inches in May through December. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding.

Included in this unit is about 20 percent soils that have strata of fine sandy loam and loamy fine sand in the upper part of the substratum and soils that are well drained.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are wetness, excess salts, and the hazard of flooding. Salinity influences the choice of crops. If the soil in this unit is drained, leached of excess salts, and irrigated, it is suited to small grain, sugar beets, corn, alfalfa, and grasses.

Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces erosion.

The addition of soil amendments such as gypsum, sulfur, and sulfuric acid should be based on soil tests. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. Land smoothing operations that include deep cuts can expose the salt- and sodium-affected substratum.

This map unit is in capability subclass IIIw, irrigated.

87-Pedigo silt loam. This very deep, somewhat poorly drained, salt- and sodium-affected soil is on bottom lands. It formed in alluvium derived from loess and volcanic ash. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,400 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 48 degrees F, and the average frost-free season is about 125 days.

Typically, the surface layer is grayish brown silt loam 11 inches thick. The underlying material to a depth of 60 inches or more is grayish brown and dark grayish brown silt loam. This soil is calcareous throughout.

Permeability of this Pedigo soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that fluctuates between depths of 30 and 60 inches in winter and spring. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The soil is subject to frequent periods of flooding in November through May.

Included in this unit is about 25 percent Hermiston silt loam, soils that have basalt at a depth of less than 60 inches, and Ahtanum silt loam.

This unit is used for nonirrigated cultivated crops and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, the hazard of flooding, wetness, the hazard of soil blowing, and excess salts. This unit is suited to spring barley because it is salt tolerant; however, it is better suited to pasture than to field crops. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Using a cropping system that includes close-growing, high-residue crops in the rotation also reduces erosion.

This map unit is in capability subclass IVw, nonirrigated.

88-Pits. This map unit consists of open pits from which soil material and underlying basalt, gravel, or semiconsolidated lacustrine sediment have been removed. Areas of Pits support little if any vegetation.

This unit is used mainly as a source of roadfill for use in surfacing roads and sand and gravel for use in concrete.

This map unit is in capability subclass VIIIs, nonirrigated.

89-Prosser very fine sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on

benches and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to bedrock ranges from 20 to 40 inches.

Permeability of this Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 10 percent Starbuck very fine sandy loam and soils that have basalt at a depth of more than 40 inches.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing basalt, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

90-Prosser very fine sandy loam, 2 to 5 percent slopes. This moderately deep, well drained soil is on benches and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to bedrock ranges from 20 to 40 inches.

Permeability of this Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 10 percent Starbuck very fine sandy loam and soils that have basalt at a depth of more than 40 inches.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation is suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on

the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which helps to maintain cloddiness of the soil. To avoid exposing basalt, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

91-Prosser very fine sandy loam, 5 to 10 percent slopes. This moderately deep, well drained soil is on benches and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to bedrock ranges from 20 to 40 inches.

Permeability of this Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 15 percent Starbuck very fine sandy loam and soils that have basalt at a depth of more than 40 inches.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing, steepness of slope, and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to basalt and the moderate available water capacity, most crops need frequent applications of irrigation water. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil increases the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which helps to maintain cloddiness of the soil. To avoid exposing basalt, land smoothing operations that include only shallow cuts are advisable.

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

92-Prosser very fine sandy loam, 10 to 15 percent slopes. This moderately deep, well drained soil is on benches and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to bedrock ranges from 20 to 40 inches.

Permeability of this Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Included in this unit is about 15 percent Starbuck very fine sandy loam and soils that have basalt at a depth of more than 40 inches.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Maintaining an adequate amount of crop residue on the surface reduces soil blowing. Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing basalt, land smoothing operations that include only shallow cuts are advisable.

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

93-Prosser very fine sandy loam, 15 to 25 percent slopes. This moderately deep, well drained soil is on benches and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to bedrock ranges from 20 to 40 inches.

Permeability of this Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Starbuck very fine sandy loam and soils that have basalt at a depth of more than 40 inches.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass IVe, nonirrigated.

94-Prosser-Starbuck very fine sandy loams, 0 to 15 percent slopes. This map unit is on benches and hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 45 percent Prosser very fine sandy loam and 35 percent Starbuck very fine sandy loam. The Prosser soil is in smooth and concave areas, and the Starbuck soil is in smooth and convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent soils that have basalt at a depth of 4 to 12 inches. Also included is about 10 percent soils that have a stony surface layer, Schawana loamy fine sand, soils that are underlain by basalt at a depth of more than 40 inches, and Rock outcrop.

The Prosser soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

The Starbuck soil is shallow and well drained. It formed in loess, colluvium, and alluvium. Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is yellowish brown very fine sandy loam 7 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Starbuck soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the very low available water capacity of the Starbuck soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the very low available water capacity of the Starbuck soil, the low annual precipitation, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated hay and pasture, the main limitations are steepness of slope, the very low available water capacity of the Starbuck soil, and the hazard of soil blowing. The main irrigated crops are alfalfa and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the depth to basalt and the very low available water capacity of the Starbuck soil, most crops need frequent applications of irrigation water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing basalt, land smoothing operations that include only shallow cuts are advisable.

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

95-Prosser-Starbuck complex, 15 to 45 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 40 percent Prosser very fine sandy loam and 35 percent Starbuck stony very fine sandy loam. The Prosser soil is in smooth and concave areas, and the Starbuck soil is in smooth and convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 15 percent soils that are underlain by basalt at a depth of 4 to 12 inches. Also included is about 10 percent soils that have a stony surface layer, Schawana loamy fine sand, soils that are underlain by basalt at a depth of more than 40 inches, and Rock outcrop.

The Prosser soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Starbuck soil is shallow and well drained. It formed in loess, colluvium, and alluvium. Typically, the surface layer is brown stony very fine sandy loam 5 inches thick. The subsoil is yellowish brown very fine sandy loam 10 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Starbuck soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by stones on the surface and the very low available water capacity of the Starbuck soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The unit is suited to rangeland seeding. The main limitations for seeding are the stones on the surface and the very low available water capacity of the Starbuck soil and the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

96-Quincy sand, 5 to 25 percent slopes, eroded. This very deep, somewhat excessively drained soil is on active dunes. It formed in sand derived from mixed sources. This soil is mainly barren of vegetation. Elevation is 380 to 1,200 feet. The average annual

precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is grayish brown sand 9 inches thick. The substratum to a depth of 60 inches or more is grayish brown sand.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Included in this unit is about 15 percent Quincy fine sand.

This unit is used mainly for wildlife habitat. It is also used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of soil blowing, and the low available water capacity. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope and sandy texture. Because of the sandy texture and low available water capacity, most crops need frequent, light applications of irrigation water.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring.

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

97-Quincy fine sand, 2 to 15 percent slopes. This very deep, somewhat excessively drained soil is on dunes and terraces. It formed in sand derived from mixed sources. The native vegetation is mainly grasses and shrubs. Elevation is 300 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown fine sandy loam 9 inches thick. The substratum to a depth of 60 inches or more is brown fine sand.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Included in this unit is about 15 percent Quincy sand, eroded; Quincy loamy fine sand; Winchester sand; Hezel loamy fine sand; and Burbank loamy fine sand.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing, the low annual precipitation, and the low available water capacity.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of soil blowing, and the low available water capacity. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring.

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

98-Quincy loamy fine sand, 0 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces and dunes. It formed in sand derived from mixed sources. The native vegetation is mainly grasses and shrubs. Elevation is 380 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is grayish brown loamy fine sand 9 inches thick. The underlying material to a depth of 60 inches or more is brown fine sand.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Hezel loamy fine sand, Royal loamy fine sand, Timmerman loamy sand, Quincy fine sand, Burbank loamy fine sand, and Quincy soils that have slopes of more than 15 percent.

This unit is used for irrigated crops, rangeland, irrigated hay and pasture, and homesites.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the low available water capacity, and the hazard of soil blowing. The main irrigated crops are potatoes, corn, small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of water. Land smoothing operations that include deep cuts are feasible on this unit.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop

residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing, the low annual precipitation, and the low available water capacity.

This unit is well suited to homesite development. Soil blowing can be a problem on construction sites. Cutbanks are not stable and are subject to caving in. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is the risk of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of nearby water supplies.

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

99-Quincy loamy fine sand, 15 to 35 percent slopes. This very deep, somewhat excessively drained soil is on dunes and terrace escarpments. It formed in sand derived from mixed sources. The native vegetation is mainly grasses and shrubs. Elevation is 380 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is grayish brown loamy fine sand 9 inches thick. The substratum to a depth of 60 inches or more is brown fine sand.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent Hezel loamy fine sand, Royal loamy fine sand, Timmerman loamy sand, Quincy fine sand, Burbank loamy fine sand, and Quincy soils that have slopes of more than 35 percent.

This unit is used as rangeland.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of the hazard of soil blowing, the low annual precipitation, and the low available water capacity.

This map unit is in capability subclass VIIe, nonirrigated.

100-Quinton-Schawana complex, 5 to 20 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 1,000 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 160 days.

This unit is 50 percent Quinton loamy fine sand and 35 percent Schawana cobbly loamy fine sand. The Quinton soil is in smooth and concave areas, and the Schawana is in convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent Quincy loamy fine sand. Also included is about 5 percent soils that have basalt at a depth of less than 8 inches.

The Quinton soil is moderately deep and somewhat excessively drained. It formed in eolian sand. Typically, the surface layer is brown loamy fine sand 7 inches thick. The substratum is brown loamy fine sand and gravelly loamy fine sand 15 inches thick. Basalt is at a depth of 22 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Quinton soil is rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

The Schawana soil is shallow and somewhat excessively drained. It formed in eolian deposits and in material weathered from basalt. Typically, the surface layer is brown cobbly loamy fine sand 3 inches thick. The substratum is brown gravelly very fine sandy loam 9 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 8 to 20 inches.

Permeability of the Schawana soil is moderately rapid. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as rangeland.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, bluebunch wheatgrass, big sagebrush, and stiff sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less

preferred forage plants such as rabbitbrush and cheatgrass increases. Seeding on this unit generally is not practical because of the hazard of soil blowing, the low available water capacity, and the low annual precipitation.

This map unit is in capability subclass VIIe, nonirrigated.

101-Rails silt loam, 3 to 25 percent slopes. This very deep, well drained soil is on hillsides. It formed in colluvium derived dominantly from basalt and in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 13 inches thick. The subsoil is brown silt loam 31 inches thick. The substratum to a depth of 60 inches or more is brown very gravelly silt loam and pale brown gravelly clay loam. The soil is calcareous in the substratum.

Permeability of this Rails soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 15 percent Renslow silt loam. Also included is about 5 percent Rails stony silt loam.

This unit is used as rangeland and for nonirrigated crops.

The potential plant community on this unit is mainly bluebunch wheatgrass and big sagebrush. The production of forage is limited by the hazard of water erosion. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Gully erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff. Terraces can be used in the more nearly level areas to control runoff.

This map unit is in capability subclass IVe, nonirrigated.

102-Rails silt loam, 25 to 55 percent slopes. This very deep, well drained soil is on hillsides. It formed in colluvium derived dominantly from basalt and in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 13 inches thick. The subsoil is brown silt loam 31 inches thick. The substratum to a depth of 60 inches or more is brown very gravelly silt loam and pale brown gravelly clay loam. The soil is calcareous in the substratum.

Permeability of this Rails soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 20 percent Rails stony silt loam and Kiona cobbly very fine sandy loam.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and threetip sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as threetip sagebrush, and cheatgrass increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of the steepness of slope and low annual precipitation.

This map unit is in capability subclass VIIe, nonirrigated.

103-Rails stony silt loam, 3 to 25 percent slopes. This very deep, well drained soil is on hillsides. It formed in colluvium derived dominantly from basalt and in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown stony silt loam 13 inches thick. The subsoil is brown gravelly silt loam 31 inches thick. The substratum to a depth of 60 inches or more is brown very gravelly silt loam and pale brown gravelly clay loam. The soil is calcareous in the substratum.

Permeability of this Rails soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 25 percent Rails silt loam and soils that have a cobbly or very cobbly surface layer.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are stones on the surface and the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

104-Renslow silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 11 inches thick. The subsoil is brown silt loam 29 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. The soil is calcareous in the substratum.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 10 percent Zen silt loam, Willis silt loam, and Renslow soils that have slopes of more than 5 percent.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, rangeland, irrigated hay and pasture, and homesites.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope in fall reduces runoff. Terraces can be used on the long slopes to control runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Many kinds of crops, such as small grain, peas, alfalfa, and grasses, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the rolling topography. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. If the range is overgrazed the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development and septic tank absorption fields. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

105-Renslow association. This map unit is on hills. Slope is 5 to 25 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

This unit is 60 percent Renslow silt loam, 5 to 15 percent slopes, and 30 percent Renslow silt loam, 15 to 25 percent slopes. Renslow silt loam, 5 to 15 percent slopes, is on broad ridges, and Renslow silt loam, 15 to 25 percent slopes, is on broad ridges and hillsides.

Included in this unit are small areas of severely eroded soils in convex areas, soils along drainageways that have basalt at a depth of less than 20 inches, Zen silt loam, Willis silt loam, and Renslow soils that have slopes of more than 25 percent. Included areas make up about 10 percent of the total acreage.

Renslow silt loam, 5 to 15 percent slopes, is very deep and well drained. It formed in loess. Typically, the

surface layer is grayish brown silt loam 11 inches thick. The subsoil is brown silt loam 29 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. The soil is calcareous in the substratum.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Renslow silt loam, 15 to 25 percent slopes, is very deep and well drained. It formed in loess. Typically, the surface layer is grayish brown and brown silt loam 11 inches thick. The subsoil is brown silt loam 29 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. The soil is calcareous in the substratum.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Terraces can be used in the more nearly level areas to control erosion. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. Many kinds of crops, such as small grain, peas, alfalfa, and grasses, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil increases the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

Renslow silt loam, 5 to 15 percent slopes, is in capability subclasses IIIe, nonirrigated, and IVe, irrigated, and Renslow silt loam, 15 to 25 percent slopes, is in capability subclass IVe, nonirrigated and irrigated.

106-Renslow silt loam, 25 to 35 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 11 inches thick. The subsoil is brown silt loam 29 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. The soil is calcareous in the substratum.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazards of water erosion is high.

Included in this unit is about 20 percent severely eroded soils in convex areas, Willis silt loam on midslopes and shoulders, and Zen silt loam.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, steepness of slope, and the hazard of erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals.

This unit is suited to rangeland seeding. The main limitations for seeding are the steepness of slope and low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass IVe, nonirrigated.

107-Renslow-Willis silt loams, 0 to 15 percent slopes. This map unit is on hills. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 135 days.

This unit is 50 percent Renslow silt loam and 30 percent Willis silt loam. The Renslow soil is in smooth and concave areas, and the Willis soil is in smooth and convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent soils that are severely eroded and are in convex areas. Also included is about 10 percent Renslow soils that have slopes of more than 15 percent and soils that are underlain by a hardpan at a depth of less than 20 inches.

The Renslow soil is very deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam 11 inches thick. The subsoil is brown silt loam 29 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. The soil is calcareous in the substratum.

Permeability of the Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Willis soil is well drained. It is moderately deep over a hardpan. The soil formed in loess. Typically, the surface layer is grayish brown silt loam 10 inches thick. The subsoil is brown silt loam 8 inches thick. The substratum is pale brown silt loam 5 inches thick. A hardpan is at a depth of 23 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Willis soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the moderate available water capacity of the Willis soil, the low annual precipitation, and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Terraces can be used to control runoff in the more nearly level areas.

If this unit is used for irrigated crops, the main limitations are the moderate available water capacity of the Willis soil, the hazard of water erosion, and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Slope, sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of the slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing and high-residue crops in the rotation reduces water erosion. Proper management of hayland and pastureland also helps to control erosion. To avoid exposing the hardpan in the Willis soil, land smoothing operations that include only shallow cuts are advisable.

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

108-Renslow-Willis silt loams, 15 to 25 percent slopes. This map unit is on hills. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 135 days.

This unit is 50 percent Renslow silt loam and 30 percent Willis silt loam. The Renslow soil is in smooth and concave areas, and the Willis soil is in smooth and convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent soils that are severely eroded and are in convex areas. Also included is about 10 percent Renslow soils that have slopes of more than 25 percent or less than 15 percent and soils that are underlain by a hardpan at a depth of less than 20 inches.

The Renslow soil is very deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam 11 inches thick. The subsoil is brown silt loam 29 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. The soil is calcareous in the substratum.

Permeability of the Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Willis soil is well drained. It is moderately deep over a hardpan. The soil formed in loess. Typically, the surface layer is grayish brown silt loam 10 inches thick. The subsoil is brown silt loam 8 inches thick. The substratum is pale brown silt loam 5 inches thick. A hardpan is at a depth of 23 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Willis soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated crops. It is also used as rangeland.

If this unit is used for nonirrigated crops, the main limitations are steepness of slope, the low annual precipitation, and the hazard of water erosion and the moderate available water capacity of the Willis soil. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. The production of forage is limited by the moderate available water capacity of the Willis soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the moderate available water capacity of the Willis soil and the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass IVe, nonirrigated.

109-Ritzville silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 1,800 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 6 inches thick. The subsoil is brown silt loam 33 inches thick. The upper 12 inches of the substratum is brown silt loam, and the lower part to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous in the substratum.

Permeability of this Ritzville soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 10 percent Willis silt loam and Ritzville soils that have slopes of more than 5 percent. This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Terraces can be used to control runoff.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Many kinds of crops, such as small grain, peas, alfalfa, and grasses, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the rolling topography. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

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

110-Ritzville association. This map unit is on hills. Slope is 5 to 25 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 1,800 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 150 days.

This unit is 60 percent Ritzville silt loam, 5 to 15 percent slopes, and 30 percent Ritzville silt loam, 15 to 25 percent slopes. Ritzville silt loam, 5 to 15 percent slopes, is on broad ridges, and Ritzville silt loam, 15 to 25 percent slopes, is on hillsides.

Included in this unit are small areas of Willis silt loam, soils along drainageways that have basalt at a depth of less than 40 inches, and Ritzville soils that have slopes of more than 25 percent. Included areas make up about 10 percent of the total acreage.

Ritzville silt loam, 5 to 15 percent slopes, is very deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam 6 inches thick. The subsoil is brown silt loam 33 inches thick. The substratum to a depth of 60 inches or more is brown and pale brown silt loam. The soil is calcareous in the substratum.

Permeability of this Ritzville soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Ritzville silt loam, 15 to 25 percent slopes, is very deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam 6 inches thick. The subsoil is brown silt loam 33 inches thick. The substratum to a depth of 60 inches or more is brown and pale brown silt loam. The soil is calcareous in the substratum.

Permeability of this Ritzville soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated crops. It is also used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Terraces can be used to control runoff in the more nearly level areas.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. Many kinds of crops, such as small grain, peas, alfalfa, and grasses, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Proper management of pastureland and hayland also helps to control erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

Ritzville silt loam, 5 to 15 percent slopes, is in capability subclasses IIIe, nonirrigated, and IVe, irrigated, and Ritzville silt loam, 15 to 25 percent slopes, is in capability subclass IVe, nonirrigated and irrigated.

111-Roloff silt loam, 0 to 25 percent slopes. This moderately deep, well drained soil is on benches and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,200 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown silt loam 11 inches thick. The subsoil is yellowish brown silt loam 6 inches thick. The substratum is yellowish brown silt loam 12 inches thick. Basalt is at a depth of 29 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Roloff soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent soils that have basalt at a depth of less than 20 inches or more than 40 inches and soils that have a cobbly surface layer.

This unit is used mainly for nonirrigated crops. It is also used as rangeland and for irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, the hazard of water erosion, and the moderate available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion

is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope in fall reduces runoff. Gully erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of water erosion, and the moderate available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to basalt and the moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing basalt, land smoothing operations that include only shallow cuts are advisable.

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

112-Roloff-Bakeoven complex, 5 to 25 percent slopes. This map unit is on benches and hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,200 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 145 days.

This unit is 50 percent Roloff silt loam and 25 percent Bakeoven very cobbly loam. The Roloff soil is in smooth areas, and the Bakeoven soil is in convex areas and in small depressional areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent soils that have basalt at a depth of 12 to 20 inches or more than 40 inches, Strat stony loam, and Rock outcrop.

The Roloff soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown silt loam 11 inches thick. The subsoil is yellowish brown silt loam 6 inches thick. The substratum is yellowish brown silt loam 12 inches thick. Basalt is at a depth of 29 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Roloff soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material weathered from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, big sagebrush, and stiff sagebrush. The production of forage is limited by the restricted available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as big sagebrush, cheatgrass, and sixweeks fescue increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

Seeding on the Bakeoven soil generally is not practical because of the very shallow depth to basalt, very cobbly surface layer, very low available water capacity, and low annual precipitation. Seeding on the Roloff soil is limited by the low annual precipitation.

This map unit is in capability subclass VIe, nonirrigated.

113-Royal loamy fine sand, 0 to 10 percent slopes. This very deep, well drained soil is on foot slopes and terraces. It formed in sandy alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown loamy fine sand 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 60 inches or more is brown very fine sandy loam and light

brownish gray loamy fine sand and loamy sand. The soil is calcareous in the substratum.

Permeability of this Royal soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent Quincy loamy fine sand. Also included is about 15 percent Royal very fine sandy loam, Sagehill very fine sandy loam, soils that have a carbonate accumulation at a depth of more than 24 inches, Timmerman loamy sand, Burbank loamy fine sand, and Royal soils that have slopes of more than 10 percent.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are steepness of slope and the hazard of soil blowing. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the sandy texture of the surface layer, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the loamy sand substratum.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the sandy texture of the surface layer. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing and the low annual precipitation.

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

114-Royal loamy fine sand, 10 to 25 percent slopes. This very deep, well drained soil is on foot slopes and terraces. It formed in sandy alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown loamy fine sand 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 60 inches or more is brown very fine sandy loam and light brownish gray loamy fine sand and loamy sand. The soil is calcareous in the substratum.

Permeability of this Royal soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent Quincy loamy fine sand. Also included is about 15 percent Royal very fine sandy loam, Sagehill very fine sandy loam, soils that have a carbonate accumulation at a depth of more than 24 inches, Timmerman loamy sand, and Burbank loamy fine sand.

This unit is used for rangeland, for irrigated cultivated crops, hay, and pasture, and as homesites.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing, and water erosion and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as alfalfa, grasses, and small grain. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the sandy texture of the surface layer and steepness of slope. Because of the sandy texture of the surface layer, most crops need frequent applications of water. Using a cropping system that includes close-growing and high-residue crops in the rotation reduces erosion. Land smoothing operations that include deep cuts can expose the loamy sand substratum.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the sandy texture of the surface layer. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing and the low annual precipitation.

This unit is poorly suited to homesite development. The main limitation for use as homesites is steepness of slope. Special design of buildings is needed to overcome this limitation. Soil blowing can be a problem on construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

The main limitation for septic tank absorption fields is slope, which can cause lateral seepage and surfacing of effluent in downslope areas.

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

115-Royal very fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on foot slopes and terraces. It formed in sandy alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 60 inches or more is brown very fine sandy loam and light brownish gray loamy fine sand and loamy sand. The soil is calcareous in the substratum.

Permeability of this Royal soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Sagehill very fine sandy loam, soils that have a carbonate accumulation at a depth of more than 24 inches, Timmerman coarse sandy loam, and Royal soils that have slopes of more than 2 percent. Also included is about 15 percent Quincy loamy fine sand and Royal loamy fine sand.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Low-residue crops can be grown if the unit is adequately protected from soil blowing. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the loamy sand substratum, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

116-Royal very fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on foot slopes and terraces. It formed in sandy alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 60 inches or more is brown very fine sandy loam and light brownish gray loamy fine sand and loamy sand. The soil is calcareous in the substratum.

Permeability of this Royal soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Sagehill very fine sandy loam, soils that have a carbonate accumulation at a depth of more than 24 inches, Timmerman coarse sandy loam, and Royal soils that have slopes of more than 5 percent. Also included is about 15 percent Quincy loamy fine sand and Royal loamy fine sand.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by

practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the loamy sand substratum, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

117-Royal very fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on foot slopes and terraces. It formed in sandy alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 60 inches or more is brown very fine sandy loam and light brownish gray loamy fine sand and loamy sand. The soil is calcareous in the substratum.

Permeability of this Royal soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 20 percent Sagehill very fine sandy loam, soils that have a carbonate accumulation at a depth of more than 24 inches, Timmerman coarse sandy loam, and Royal soils that have slopes of more than 10 percent. Also included is about 15 percent Quincy loamy fine sand and Royal loamy fine sand.

This unit is used for irrigated cultivated crops, rangeland, and irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the loamy sand substratum, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

118-Royal very fine sandy loam, cemented substratum, 2 to 5 percent slopes. This well drained soil is on foot slopes. It is deep over a hardpan. The soil formed in sandy alluvium. Elevation is 600 to 1,300 feet. The native vegetation is mainly grasses and shrubs. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 45 inches is brown very fine sandy loam and light brownish gray loamy fine sand. A hardpan is at a depth of 45 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 40 to 60 inches.

Permeability of this Royal soil is moderately rapid above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Sagehill very fine sandy loam, Taunton fine sandy loam, and Royal soils that have a cemented substratum and have slopes of more than 5 percent. Also included is about 15 percent Quincy loamy fine sand and Royal loamy fine sand.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

119-Royal very fine sandy loam, cemented substratum, 5 to 10 percent slopes. This well drained soil is on foot slopes and terraces. It is deep over a hardpan. The soil formed in sandy alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 10 inches thick. The subsoil is brown very fine sandy loam 6 inches thick. The substratum to a depth of 45 inches is brown very fine sandy loam and light brownish gray loamy fine sand. A hardpan is at a depth of 45 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 40 to 60 inches.

Permeability of this Royal soil is moderately rapid above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Sagehill very fine sandy loam, Taunton fine sandy loam, and Royal soils that have a cemented substratum and have slopes of more than 10 percent. Also included is about 15 percent Quincy loamy fine sand and Royal loamy fine sand.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

120-Rubble land-Rock outcrop complex. This map unit is on hillsides. The native vegetation is mainly lichens on rocks and scattered grasses and shrubs in pockets of soil material. Slope is 25 to 65 percent. Elevation is 600 to 2,300 feet. The average annual

precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

This unit is about 50 percent Rubble land and 30 percent Rock outcrop. The Rubble land is on foot slopes, and the Rock outcrop occurs as cliffs above foot slopes. These cliffs are nearly perpendicular and are a few feet to about 500 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 20 percent Kiona stony very fine sandy loam, Lickskillet very cobbly loam, and Bakeoven very cobbly loam.

Rubble land consists of areas of pebbles, cobbles, stones, and boulders.

Rock outcrop consists of areas of exposed basalt.

This unit is used mainly for wildlife habitat. The areas of Rubble land are a good source of material for road ballast.

Grazing on this unit is limited by the very low production of forage and the difficulty of animal movement.

This map unit is in capability subclass VIIIs, nonirrigated.

121-Sagehill very fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam and light brownish gray silt loam. The soil is calcareous in the substratum.

Permeability of this Sagehill soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Warden silt loam, Royal very fine sandy loam, Kennewick fine sandy loam, Quincy loamy fine sand, Hezel loamy fine sand, and Sagehill soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer, increases the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IIe, irrigated.

122-Sagehill very fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam and light brownish gray silt loam. The soil is calcareous in the substratum.

Permeability of this Sagehill soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Warden silt loam, Royal very fine sandy loam, Kennewick fine sandy loam, Quincy loamy fine sand, Hezel loamy fine sand, and Sagehill soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid

excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IIe, irrigated.

123-Sagehill very fine sandy loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam and light brownish gray silt loam. The soil is calcareous in the substratum.

Permeability of this Sagehill soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Warden silt loam, Royal very fine sandy loam, Kennewick silt loam, Quincy loamy fine sand, Hezel loamy fine sand, and Sagehill soils that have slopes of more than 10 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil increases the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IIIe, irrigated.

124-Sagehill very fine sandy loam, 10 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray very fine sandy loam and light brownish gray silt loam. The soil is calcareous in the substratum.

Permeability of this Sagehill soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Included in this unit is about 20 percent Warden silt loam, Royal very fine sandy loam, Kennewick silt loam, Quincy loamy fine sand, Hezel loamy fine sand, and Sagehill soils that have slopes of more than 15 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IVe, irrigated.

125-Sagemoor silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about

50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is light brownish gray silt loam 9 inches thick. The subsoil is pale brown silt loam 10 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and grayish brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Sagemoor soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 30 percent Warden silt loam. Also included is about 5 percent Wahluke very fine sandy loam, Kennewick silt loam, and Sagemoor soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

This unit has few limitations for irrigated crops. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer, also increases the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability class I, irrigated.

126-Sagemoor silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is light brownish gray silt loam 9 inches thick. The subsoil is pale brown silt loam 10 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and grayish brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Sagemoor soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 25 percent Warden silt loam, Wahluke very fine sandy loam, Kennewick silt loam, and Sagemoor soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIe, irrigated.

127-Sagemoor silt loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is light brownish gray silt loam 9 inches thick. The subsoil is pale brown silt loam 10 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and grayish brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Sagemoor soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 25 percent Warden silt loam, Wahluke very fine sandy loam, Kennewick silt loam, and Sagemoor soils that have slopes of more than 10 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIIe, irrigated.

128-Sagemoor silt loam, 10 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine deposits that have a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches; the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is light brownish gray silt loam 9 inches thick. The subsoil is pale brown silt loam 10 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and grayish brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Sagemoor soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 25 percent Warden silt loam, Wahluke very fine sandy loam, Kennewick silt loam, and Sagemoor soils that have slopes of more than 15 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the calcareous substratum, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IVe, irrigated.

129-Saltese muck. This very deep, very poorly drained soil is in basins. It formed in decomposed reeds, sedges, and other plant material and in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,050 to 1,300 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 125 days.

Typically, the surface tier is black muck 17 inches thick. The underlying tier to a depth of 60 inches or more is black organic material.

Permeability of this Saltese soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that fluctuates between depths of 6 and 36 inches in February through May. Runoff is very slow, and water erosion is not a hazard. This soil is subject to frequent periods of flooding in February through May.

Included in this unit is about 5 percent soils along Crab Creek that have a silt loam surface layer and Umapine silt loam and other salt- and sodium-affected soils that are mainly along Rocky Ford Creek.

This unit is used for nonirrigated cultivated crops, hay, and pasture and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are wetness and the hazard of flooding. If drained, the soil in this unit is suited to oats, wheat, barley, and grasses. Suitable management practices are drainage and returning crop residue to the soil. The water table should be at or near the surface during the nongrowing season to minimize subsidence.

The potential plant community on this unit is mainly sedge, inland saltgrass, and rush. The production of forage is limited by wetness and excess salts. If the range is overgrazed, the proportion of preferred forage plants such as redtop decreases and the proportion of less preferred forage plants such as inland saltgrass and sedge increases.

The main limitations of this unit for rangeland seeding are excess salts and wetness. Plants that tolerate wetness and excess salts should be seeded.

This map unit is in capability subclass IIIw, nonirrigated.

130-Schawana cobbly loamy fine sand, 15 to 55 percent slopes. This shallow, somewhat excessively drained soil is on hillsides. It formed in eolian deposits and in material weathered from basalt. The native

vegetation is mainly grasses and shrubs. Elevation is 500 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 160 days.

Typically, the upper layer is brown cobbly loamy fine sand 3 inches thick. Below this is brown gravelly very fine sandy loam 9 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 8 to 20 inches.

Permeability of this Schawana soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 20 percent soils that have basalt at a depth of less than 8 inches, Quinton loamy fine sand, and Quincy loamy fine sand. Also included is about 5 percent Rock outcrop.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass and stiff sagebrush. The production of forage is limited by the very low available water capacity and low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass decreases and the proportion of less preferred forage plants such as stiff sagebrush and cheatgrass increases. Seeding on this unit generally is not practical because of the very low available water capacity, steepness of slope, and low annual precipitation.

This map unit is in capability subclass VIIe, nonirrigated.

131-Schawana complex, 0 to 15 percent slopes. This map unit is on benches. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,230 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 165 days.

This unit is 40 percent Schawana loamy fine sand and 30 percent Schawana cobbly loamy fine sand. Schawana loamy fine sand is on the central part of benches, and Schawana cobbly loamy fine sand is on the outer parts of benches and in convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 15 percent soils that have basalt at a depth of less than 8 inches, 10 percent Quinton loamy fine sand and Quincy fine sand in depressional areas and on small dunes, and 5 percent Rock outcrop on the outer parts of benches.

Schawana loamy fine sand is shallow and somewhat excessively drained. It formed in eolian deposits and in material weathered from basalt. Typically, the surface layer is brown loamy fine sand 3 inches thick. The underlying material is brown very fine sandy loam 9 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 8 to 20 inches.

Permeability of this Schawana soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is high.

Schawana cobbly loamy fine sand is shallow and somewhat excessively drained. It formed in eolian deposits and in material weathered from basalt. Typically, the upper layer is brown cobbly loamy fine sand 3 inches thick. Below this is brown gravelly very fine sandy loam 9 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 8 to 20 inches.

Permeability of this Schawana soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly Sandberg bluegrass and stiff sagebrush. The production of forage is limited by the very low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass decreases and the proportion of less preferred forage plants such as stiff sagebrush and cheatgrass increases. Seeding on this unit generally is not practical because of the very low available water capacity, the hazard of soil blowing, cobbles on the surface, and the low annual precipitation.

This map unit is in capability subclass VIIe, nonirrigated.

132-Scoon silt loam, 0 to 5 percent slopes. This well drained soil is on terraces and alluvial fans. It is shallow over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 185 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The subsoil is light brownish gray silt loam 4 inches thick. The substratum is light brownish gray gravelly silt loam 6 inches thick. A hardpan is at a depth of 16 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 10 to 20 inches.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Taunton silt loam, Taunton fine sandy loam, Koehler loamy fine sand, and Sagehill very fine sandy loam.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing and the low available water capacity. The main irrigated crops are small grain, peas, alfalfa, and grasses.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Because of the depth to the hardpan and the low available water capacity, most crops need frequent, light applications of water. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduces water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, needleandthread, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low available water capacity, low annual precipitation, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

133-Scoon silt loam, 5 to 15 percent slopes. This well drained soil is on terraces and alluvial fans. It is shallow over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 185 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The subsoil is light brownish gray silt loam 4 inches thick. The substratum is light brownish gray gravelly silt loam 6 inches thick. A hardpan is at a depth of 16 inches. The soil is calcareous in the substratum.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 25 percent Taunton silt loam, Taunton fine sandy loam, Koehler loamy fine sand, and Sagehill very fine sandy loam.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, needleandthread, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low available water capacity, the low annual precipitation, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing, steepness of slope, and the low available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation systems are best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to the hardpan and the low available water capacity, most crops need frequent, light applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Soil blowing is reduced by practicing minimum tillage, which reduces pulverization of the soil and helps to maintain cloddiness. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

134-Scoon stony silt loam, 0 to 15 percent slopes. This well drained soil is on terraces and alluvial

fans. It is shallow over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 185 days.

Typically, the surface layer is light brownish gray stony silt loam 6 inches thick. The subsoil is light brownish gray gravelly silt loam 4 inches thick. The substratum is light brownish gray gravelly silt loam 6 inches thick. A hardpan is at a depth of 16 inches. Depth to the hardpan ranges from 10 to 20 inches. The soil is calcareous in the substratum.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 25 percent Taunton silt loam, Taunton fine sandy loam, Koehler loamy fine sand, and Sagehill very fine sandy loam.

This unit is used as rangeland, for irrigated cultivated crops, hay, and pasture, and as homesites.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, needleandthread, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are stones on the surface, the low available water capacity, the low annual precipitation, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion, steepness of slope, the low available water capacity, and stones on the surface. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the stones on the surface and steepness of slope. Because of the depth to the hardpan and low available water capacity, most crops need frequent, light applications of water. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Tillage is limited by stones on or near the surface of the soil. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

This unit is poorly suited to homesite development. The main limitation for use as homesites and for septic tank absorption fields is depth to the cemented pan, which hinders excavation and limits the capacity of the absorption field. Construction sites should be disturbed as little as possible. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

135-Scoon complex, 0 to 10 percent slopes. This map unit is on terraces. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 185 days.

This unit is 50 percent Scoon very fine sandy loam, shallow, and 40 percent Scoon very fine sandy loam, very shallow. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 10 percent Taunton silt loam and soils that have a hardpan at a depth of less than 6 inches.

Scoon very fine sandy loam, shallow, is well drained. It is shallow over a hardpan. The soil formed in loess. Typically, the surface layer is light brownish gray very fine sandy loam 6 inches thick. The subsoil is light brownish gray very fine sandy loam 4 inches thick. The substratum is light brownish gray gravelly very fine sandy loam 6 inches thick. A hardpan is at a depth of 16 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 10 to 20 inches.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Scoon very fine sandy loam, very shallow, is well drained. It is very shallow over a hardpan. The soil formed in loess. Typically, the surface layer is light brownish gray very fine sandy loam 6 inches thick. The subsoil is light brownish gray gravelly very fine sandy loam 2 inches thick. A hardpan is at a depth of 8 inches. Depth to the hardpan ranges from 6 to 10 inches.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is very low. Effective rooting depth is 6 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are steepness of slope, restricted available water capacity, and the hazards of water erosion and soil blowing. The main irrigated crops are small grain, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is best suited to this unit because of the depth to the hardpan. Because of the depth to the hardpan and the restricted available water capacity, most crops need frequent applications of water. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the restricted available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, needleandthread, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the restricted available water capacity, the low annual precipitation, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedings. The unit can be seeded to adapted grasses.

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

136-Shano silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The lower part of the substratum is calcareous.

Permeability of this Shano soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 5 percent Adkins very fine sandy loam, Burke silt loam, and Shano soils that have slopes of more than 2 percent.

This unit is used for nonirrigated crops and for irrigated cultivated crops, orchards, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitation is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

This unit has few limitations for irrigated crops. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts can expose the lower part of the substratum, which is calcareous.

This map unit is in capability class I, irrigated, and subclass IVc, nonirrigated.

137-Shano silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The lower part of the substratum is calcareous.

Permeability of this Shano soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 5 percent Adkins very fine sandy loam, Burke silt loam, and Shano soils that have slopes of more than 5 percent.

This unit is used for nonirrigated crops, for irrigated cultivated crops, orchards, hay, and pasture, and as homesites.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts can expose the lower part of the substratum, which is calcareous.

This unit is well suited to homesite development and septic tank absorption fields. Dustiness can be a problem on large construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

138-Shano silt loam, 5 to 10 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The lower part of the substratum is calcareous.

Permeability of this Shano soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 10 percent Adkins very fine sandy loam, Burke silt loam, and soils along drainageways that have basalt at a depth of less than 40 inches.

This unit is used mainly for nonirrigated and irrigated cultivated crops. It is also used as rangeland, for irrigated orchards, hay, and pasture, and as homesites.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Erosion in orchards is reduced by growing perennial cover crops. Land smoothing operations that include deep cuts can expose the lower part of the substratum, which is calcareous.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage

plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This unit is well suited to homesite development and septic tank absorption fields. Dustiness can be a problem on construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

139-Shano silt loam, 10 to 15 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The lower part of the substratum is calcareous.

Permeability of this Shano soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 15 percent Adkins very fine sandy loam, Burke silt loam, and soils along drainageways that have basalt at a depth of less than 40 inches.

This unit is used for nonirrigated crops, rangeland, and irrigated cultivated crops, hay, and pasture.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Land smoothing operations that include deep cuts can expose the lower part of the substratum, which is calcareous.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of water erosion. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

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

140-Shano silt loam, 15 to 35 percent slopes. This very deep, well drained soil is on hills. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. The lower part of the substratum is calcareous.

Permeability of this Shano soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 20 percent Adkins very fine sandy loam, Shano soils that have slopes of more than 35 percent, Burke silt loam, and soils along drainageways that have basalt at a depth of less than 40 inches.

This unit is used mainly as rangeland. It is also used for nonirrigated crops.

The potential plant community on this unit is mainly bluebunch wheatgrass, Cusick bluegrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such

methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of water erosion. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, steepness of slope, and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Production of spring wheat and barley is low, and the small amount of straw produced must be carefully managed to control erosion. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

This map unit is in capability subclass IVe, nonirrigated.

141-Starbuck very fine sandy loam, 0 to 15 percent slopes. This shallow, well drained soil is on benches and hillsides. It formed in loess and in material weathered from basalt. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown very fine sandy loam 8 inches thick. The subsoil is yellowish brown silt loam 7 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of this Starbuck soil is moderate. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 20 percent Prosser very fine sandy loam, soils that have basalt at a depth of less than 12 inches or more than 20 inches, and Schawana cobbly loamy fine sand. Also included is about 5 percent soils that are underlain by sandy and gravelly material or by a hardpan.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, needleandthread, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low available water capacity, the low annual precipitation, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing, steepness of slope, and the low available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to basalt and the low available water capacity, most crops need frequent, light applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing the basalt, land smoothing operations that include only shallow cuts are advisable.

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

142-Starbuck stony silt loam, 0 to 30 percent slopes. This shallow, well drained soil is on benches and hillsides. It formed in loess and in material weathered from basalt. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown stony silt loam 8 inches thick. The subsoil is yellowish brown gravelly silt loam 7 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of this Starbuck soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 15 percent Prosser very fine sandy loam, soils that have basalt at a depth of less than 12 inches or more than 20 inches, and Schawana loamy fine sand. Also included is about 5 percent soils that are underlain by sandy and gravelly material or by a hardpan.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. The production of forage is limited by the very low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, needleandthread, and cheatgrass increases. Areas that

are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are stones on the surface, the very low available water capacity, and the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

143-Starbuck-Bakeoven-Rock outcrop complex, 0 to 45 percent slopes. This map unit is on benches, ridgetops, and hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 550 to 2,700 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 30 percent Starbuck stony very fine sandy loam, 30 percent Bakeoven very cobbly loam, and 15 percent Rock outcrop. The Starbuck soil is in smooth areas, the Bakeoven soil is in smooth and convex areas, and Rock outcrop is on the outer edge of benches and in convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent soils that have basalt at a depth of more than 20 inches, soils that have sandy and gravelly material at a depth of 16 to 28 inches, and somewhat poorly drained soils in basins.

The Starbuck soil is shallow and well drained. It formed in loess and in material weathered from basalt. Typically, the surface layer is brown stony very fine sandy loam 5 inches thick. The subsoil is yellowish brown gravelly fine sandy loam 10 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of this Starbuck soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Bakeoven soil is very shallow and well drained. It formed in loess and in material weathered from basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is yellowish brown very gravelly loam 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is very low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

Rock outcrop consists of exposed areas of basalt. This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, big sagebrush, and stiff sagebrush. The production of forage is limited by the very low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, needleandthread, sixweeks fescue, and cheatgrass increases. Seeding on this unit generally is not practical because of the stones and cobbles on the surface, areas of Rock outcrop, very low available water capacity, and low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

144-Starbuck-Kiona stony silt loams, 30 to 65 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

This unit is 45 percent Starbuck stony silt loam and 30 percent Kiona stony silt loam. The Starbuck soil is on midslopes and shoulders, and the Kiona soil is on hillsides. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent Bakeoven very cobbly loam, Prosser very fine sandy loam, and Rock outcrop.

The Starbuck soil is shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown stony silt loam 5 inches thick. The subsoil is yellowish brown gravelly silt loam 10 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Starbuck soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Kiona soil is very deep and well drained. It formed in colluvium derived from loess and basalt. Typically, the surface layer is brown stony silt loam 3 inches thick. The subsoil is brown cobbly silt loam 16 inches thick. The substratum to a depth of 60 inches or more is brown very cobbly sandy loam. The soil is calcareous below a depth of 19 inches.

Permeability of this Kiona soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the very low available water capacity of the Starbuck soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion

of less preferred forage plants such as big sagebrush, needleandthread, and cheatgrass increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on this unit generally is not practical because of steepness of slope, stones on the surface, the very low available water capacity of the Starbuck soil, and the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

145-Starbuck-Prosser complex, 0 to 25 percent slopes. This map unit is on benches and hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 600 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

This unit is 50 percent Starbuck stony very fine sandy loam and 25 percent Prosser very fine sandy loam. The Starbuck soil is in smooth and convex areas, and the Prosser is in smooth and concave areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent soils that have basalt at a depth of 4 to 12 inches or more than 40 inches and Rock outcrop.

The Starbuck soil is shallow and well drained. It formed in loess and in material derived from basalt. Typically, the surface layer is brown stony very fine sandy loam 5 inches thick. The subsoil is yellowish brown gravelly fine sandy loam 10 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Starbuck soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Prosser soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown very fine sandy loam 5 inches thick. The subsoil is brown very fine sandy loam 11 inches thick. The substratum is brown very fine sandy loam 10 inches thick. Basalt is at a depth of 26 inches. The soil is calcareous in the substratum. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Prosser soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the very low available water capacity of the Starbuck soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Thurber needlegrass decreases and the proportion of less preferred forage plants such as big sagebrush, needleandthread, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the very low available water capacity and stones on the surface of the Starbuck soil, the low annual precipitation, and the hazard of soil blowing on the Prosser soil. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

146-Strat gravelly loam, 0 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown gravelly loam 8 inches thick. The subsoil is yellowish brown very gravelly loam 10 inches thick. The upper 5 inches of the substratum is yellowish brown very cobbly loam, and the lower part to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Strat soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Strat cobbly loam, Strat stony loam, and soils that have sandy and gravelly material at a depth of 12 to 16 inches.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion, steepness of slope, and the moderate available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the depth to extremely gravelly coarse sand and the moderate available water capacity, most crops need frequent, light applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

147-Strat cobbly loam, 0 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown cobbly loam 8 inches thick. The subsoil is yellowish brown very gravelly loam 10 inches thick. The upper 5 inches of the substratum is yellowish brown very cobbly loam, and the lower part to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Strat soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent Strat very cobbly loam, Strat stony loam, Strat gravelly loam, and soils that have sandy and gravelly material at a depth of 12 to 16 inches.

This unit is used as rangeland and for irrigated hay and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are cobbles on the surface, the low annual precipitation, and the moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are cobbles on the surface, the hazard of water erosion, steepness of slope, and the moderate available water capacity. The main irrigated crops are alfalfa and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the depth to extremely gravelly coarse sand and the moderate available water capacity, most crops need frequent, light applications of water. Tillage is limited by cobbles on or near the surface of the soil. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

148-Strat stony loam, 0 to 25 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown stony loam 8 inches thick. The subsoil is yellowish brown very gravelly loam 10 inches thick. The upper 5 inches of the substratum is yellowish brown very cobbly loam, and the lower part to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Strat soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 15 percent soils that have a very stony loam surface layer. Also included is about 10 percent Strat cobbly loam, Strat gravelly loam, and soils that have sandy and gravelly material at a depth of 12 to 16 inches.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved

by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are stones on the surface, the low annual precipitation, and the moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

149-Strat-Stratford complex, 0 to 15 percent slopes. This map unit is on terraces. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 1,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

This unit is 40 percent Strat very cobbly loam and 35 percent Stratford gravelly loam. The Strat soil is between mounds, and the Stratford soil is on mounds. The mounds are 20 to 30 feet in diameter, 15 to 100 feet apart, and 1 foot to 3 feet high. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit between mounds are about 10 percent soils that have a stony, cobbly, or very stony surface layer and about 10 percent soils that have sandy and gravelly material at a depth of 12 to 16 inches. Included on mounds is about 5 percent soils that have sandy and gravelly material at a depth of more than 40 inches.

The Strat soil is very deep and well drained. It formed in glacial outwash that is mixed with loess in the upper part. Typically, the surface layer is brown very cobbly loam 8 inches thick. The subsoil is yellowish brown very gravelly loam 10 inches thick. The upper 5 inches of the substratum is yellowish brown very cobbly loam, and the lower part to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Strat soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Stratford soil is very deep and well drained. It formed in glacial outwash that is mixed with loess in the upper part. Typically, the surface layer is brown gravelly loam 7 inches thick. The subsoil is brown gravelly loam 13 inches thick. The upper 10 inches of the substratum is yellowish brown gravelly loam, and the lower part to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Stratford soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium and the hazard of water erosion is moderate.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the very cobbly surface layer of the Strat soil, the moderate available water capacity, and the low annual precipitation.

This map unit is in capability subclass VIIs, nonirrigated.

150-Stratford loam, 0 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in glacial outwash that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,100 to 1,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is brown loam 7 inches thick. The subsoil is brown gravelly loam 13 inches thick. The upper 10 inches of the substratum is yellowish brown gravelly loam, and the lower part to a depth of 60 inches or more is gray extremely gravelly coarse sand.

Permeability of this Stratford soil is moderate to the lower part of the substratum and very rapid through the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Strat gravelly loam, Strat cobbly loam, and Stratford soils that have slopes of more than 5 percent.

This unit is used as rangeland, for nonirrigated crops, and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. The unit can be seeded to adapted grasses.

If this unit is used for nonirrigated crops, the main limitation is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion is reduced if fall grain is seeded early and stubble mulch tillage is used.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. The main irrigated crops are small grain, alfalfa, and grasses. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing extremely gravelly coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

151-Taunton loamy fine sand, 0 to 10 percent slopes. This well drained soil is on terraces. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is brown loamy fine sand 8 inches thick. The subsoil is light brownish gray very fine sandy loam 11 inches thick. The substratum is light brownish gray gravelly fine sandy loam 8 inches thick. A hardpan is at a depth of 27 inches. Depth to the hardpan ranges from 20 to 40 inches. The soil is calcareous in the substratum.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 20 percent Koehler loamy fine sand, Quincy loamy fine sand, and Taunton fine sandy loam.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing, low available water capacity, and low annual precipitation.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of soil blowing, and the low available water capacity. The main irrigated crops are small grain, alfalfa, and grasses. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

152-Taunton fine sandy loam, 0 to 2 percent slopes. This well drained soil is on terraces. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is light brownish gray fine sandy loam 8 inches thick. The subsoil is light brownish gray very fine sandy loam 11 inches thick. The substratum is light brownish gray gravelly fine sandy loam 8 inches thick. A hardpan is at a depth of 27 inches. Depth to the hardpan ranges from 20 to 40 inches. The soil is calcareous in the substratum.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 35 percent Taunton silt loam. Also included is about 10 percent Taunton loamy fine sand, Scoon silt loam, Prosser very fine sandy loam, Koehler loamy fine sand, and soils that have a hardpan at a depth of more than 40 inches.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil

blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents soil pulverization. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

153-Taunton fine sandy loam, 2 to 5 percent slopes. This well drained soil is on terraces and alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is light brownish gray fine sandy loam 8 inches thick. The subsoil is light brownish gray very fine sandy loam 11 inches thick. The substratum is light brownish gray gravelly fine sandy loam 8 inches thick. A hardpan is at a depth of 27 inches. Depth to the hardpan ranges from 20 to 40 inches. The soil is calcareous in the substratum.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 35 percent Taunton soils that have a silt loam surface layer. Also included is about 10 percent Taunton loamy fine sand, Scoon silt loam, Prosser very fine sandy loam, Koehler loamy fine sand, and soils that have a hardpan at a depth of more than 40 inches.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents soil pulverization. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

154-Taunton fine sandy loam, 5 to 10 percent slopes. This well drained soil is on terraces and alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is light brownish gray fine sandy loam 8 inches thick. The subsoil is light brownish gray very fine sandy loam 11 inches thick. The substratum is light brownish gray gravelly fine sandy loam 8 inches thick. A hardpan is at a depth of 27 inches. Depth to the hardpan ranges from 20 to 40 inches. The soil is calcareous in the substratum.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 35 percent Taunton soils that have a silt loam surface layer. Also included is about 10 percent Taunton loamy fine sand, Scoon silt loam, Prosser very fine sandy loam, Koehler loamy fine sand, and soils that have a hardpan at a depth of more than 40 inches.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion, steepness of slope, and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Minimum tillage, which helps to maintain the tilth of the surface layer, increases the water intake rate and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents soil pulverization. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

155-Taunton fine sandy loam, 10 to 15 percent slopes. This well drained soil is on terraces and alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 175 days.

Typically, the surface layer is light brownish gray fine sandy loam 8 inches thick. The subsoil is light brownish gray very fine sandy loam 11 inches thick. The substratum is light brownish gray gravelly fine sandy loam 8 inches thick. A hardpan is at a depth of 27 inches. Depth to the hardpan ranges from 20 to 40 inches. The soil is calcareous in the substratum.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

Included in this unit is about 35 percent Taunton soils that have a silt loam surface layer. Also included is about 10 percent Taunton loamy fine sand, Scoon silt loam, Prosser very fine sandy loam, Koehler loamy fine sand, and soils that have a hardpan at a depth of more than 40 inches.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing, steepness of slope, and moderate available water capacity. The unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

156-Taunton silt loam, 0 to 2 percent slopes. This well drained soil is on terraces. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 10 percent Scoon silt loam. Also included is about 10 percent Taunton fine sandy loam and soils that have a stony surface layer, are calcareous at a depth of less than 10 inches, have basalt below a hardpan, or have a hardpan at a depth of more than 40 inches.

This unit is used for irrigated cultivated crops, as rangeland, for irrigated hay and pasture, and as homesites.

If this unit is used for irrigated crops, the main limitation is the moderate available water capacity. Many kinds of crops, such as small grain, alfalfa, grasses, sugar beets, corn, beans, peas, and potatoes, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also increases the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Maintaining the tilth of the surface layer increases the water intake rate and reduces water erosion. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

If the range is in good or excellent condition, the native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This unit is poorly suited to homesite development. The main limitation for use as homesites and for septic tank absorption fields is the depth to the hardpan, which hinders excavation and limits the capacity of the absorption field. Construction sites should be disturbed as little as possible. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

157-Taunton silt loam, 2 to 5 percent slopes. This well drained soil is on alluvial fans and terraces. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 10 percent Scoon silt loam and Finley very fine sandy loam. Also included is about 10 percent Taunton fine sandy loam; soils that have a stony surface layer, are calcareous at a depth of less than 10 inches, have basalt below a hardpan, or have a hardpan at a depth of more than 40 inches; and Taunton soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, as rangeland, for irrigated hay and pasture, and as homesites.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and moderate available water capacity. Many kinds of crops, such as small grain, alfalfa, sugar beets, corn, beans, peas, and potatoes, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also increases the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, also increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer, increases the water intake rate and reduces water erosion. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush imcreases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This unit is poorly suited to homesite development. The main limitation for use as homesites and for septic tank absorption fields is the depth to the hardpan, which hinders excavation and limits the capacity of the absorption field. Dustiness can be a problem during construction on large construction sites. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

158-Taunton silt loam, 5 to 10 percent slopes. This well drained soil is on old alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 10 percent Scoon silt loam and Finley very fine sandy loam. Also included is about 10 percent Taunton fine sandy loam; soils that have a stony surface layer, are calcareous at a depth of less than 10 inches, have basalt below a hardpan, or have a hardpan at a depth of more than 40 inches; and Taunton soils that have slopes of more than 10 percent.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of water erosion, and moderate available water capacity. Many kinds of crops, such as small grain, alfalfa, sugar beets, corn, beans, peas, and potatoes, can be grown under irrigation.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

159-Taunton silt loam, 10 to 15 percent slopes. This well drained soil is on old alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 10 percent Scoon silt loam and Finley very fine sandy loam. Also included is about 10 percent Taunton fine sandy loam; soils that have a stony surface layer, are calcareous at a depth of less than 10 inches, have basalt below a hardpan, or have a hardpan at a depth of more than 40 inches; and Taunton soils that have slopes of more than 15 percent.

This unit is used for irrigated hay and pasture and as homesites and rangeland.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of water erosion, and moderate available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This unit is poorly suited to homesite development. The main limitation for use as homesites and for septic tank absorption fields is the depth to the hardpan, which hinders excavation and limits the capacity of the absorption field. Construction sites should be disturbed as little as possible. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

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

160-Taunton silt loam, 15 to 25 percent slopes. This well drained soil is on alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 10 percent Scoon silt loam and Finley very fine sandy loam. Also included is about 10 percent Taunton fine sandy loam; soils that have a stony surface layer, are calcareous at a depth of less than 10 inches, or have a hardpan at a depth of more than 40 inches; and Taunton soils that have slopes of more than 25 percent.

This unit is used mainly as rangeland. It is also used for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big

sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and droughtiness. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, moderate available water capacity, and the hazard of water erosion. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

161-Taunton stony silt loam, 0 to 25 percent slopes. This well drained soil is on alluvial fans. It is moderately deep over a hardpan. The soil formed in loess and alluvium. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown stony silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Finley very cobbly fine sandy loam, Finley cobbly very fine sandy loam, and Scoon silt loam. Also included is about 10 percent Taunton fine sandy loam; soils that are calcareous at a depth of less than 10 inches, have basalt below a hardpan, or have a hardpan at a depth of more than 40 inches; and Taunton soils that have slopes of more than 25 percent.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are stones on the surface, the low annual precipitation, and the moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, stones on the surface, the hazard of water erosion, and moderate available water capacity. The main irrigated crops are alfalfa and grasses. Tillage is limited because of the stones on or near the surface of the soil. Because of the stones on the surface and steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the depth to the hardpan and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the hardpan, land smoothing operations that include only shallow cuts are advisable.

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

162-Taunton-Finley complex, 0 to 10 percent slopes. This map unit is on terraces. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,500 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is 170 days.

This unit is 40 percent Taunton silt loam and 35 percent Finley cobbly very fine sandy loam. The Taunton soil is in convex and smooth areas between drainageways, and the Finley soil is in concave and smooth areas along drainageways. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 25 percent Scoon very fine sandy loam, Finley very cobbly fine sandy loam, Finley gravelly fine sandy loam, Taunton loamy fine sand, and Taunton and Finley soils that have slopes of more than 10 percent.

The Taunton soil is well drained. It is moderately deep over a hardpan. The soil formed in loess and alluvium. Typically, the surface layer is brown silt loam 8 inches thick. The subsoil is pale brown silt loam 11 inches thick. The substratum is pale brown and very pale brown gravelly silt loam 8 inches thick. A hardpan is at a depth of 27 inches. The soil is calcareous in the substratum. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Taunton soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

The Finley soil is very deep and well drained. It formed in gravelly alluvium. Typically, the surface layer is brown cobbly very fine sandy loam 8 inches thick. The subsoil is brown extremely cobbly fine sandy loam and very cobbly sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray extremely gravelly loamy sand. The soil is calcareous in the substratum.

Permeability of the Finley soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

This unit is used mainly as rangeland. It is also used for irrigated hay and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the restricted available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as cheatgrass and big sagebrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

The main limitations of this unit for rangeland seeding are the low annual precipitation and the restricted available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazard of water erosion, cobbles on the surface of the Finley soil, and restricted available water capacity. The main irrigated crops are alfalfa and grasses. Tillage is limited because of the cobbles on or near the surface of the Finley soil.

Because of the steepness of slope and the cobbles on the surface of the Finley soil, sprinkler, drip, or trickle irrigation is best suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Because of the restricted available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the extremely gravelly loamy sand in the Finley soil and the hardpan in the Taunton soil, land smoothing operations that include only shallow cuts are advisable.

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

163-Timentwa very fine sandy loam, 0 to 15 percent slopes. This deep, well drained soil is on till plains. It formed in glacial till that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 2,300 to 3,000 feet. The average annual precipitation is about 13 inches, the average annual temperature is about 47 degrees F, and the average frost-free season is about 125 days.

Typically, the surface layer is dark grayish brown very fine sandy loam 14 inches thick. The subsoil is brown gravelly very fine sandy loam 23 inches thick. The upper 6 inches of the substratum is grayish brown gravelly fine sandy loam; the next 4 inches is discontinuous, weakly lime- and silica-cemented lenses about 1/8 inch thick; and the lower part to a depth of 60 inches or more is gray very gravelly fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Timentwa soil is moderate above and below the cemented lenses and moderately slow through the lenses. Available water capacity is moderate. Effective rooting depth is limited by the cemented lenses at a depth of 40 to 55 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 15 percent soils that have a stony or cobbly surface layer and Timentwa soils that have slopes of more than 15 percent.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitation is the moderate available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Terraces can be used to control runoff in the less sloping areas.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and threetip sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass

and Idaho fescue decreases and the proportion of less preferred forage plants such as threetip sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass IIIe, nonirrigated.

164-Timmerman loamy sand, 0 to 5 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash and alluvium that is mixed with eolian material in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown loamy sand 8 inches thick. The subsoil is pale brown coarse sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and very dark gray loamy coarse sand and coarse sand. The soil is calcareous in the substratum.

Permeability of this Timmerman soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 10 percent Timmerman coarse sandy loam, Quincy loamy fine sand, Royal loamy fine sand, and Winchester sand.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and moderate available water capacity. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses.

Because of the loamy sand surface layer, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of the moderate available water capacity, most crops need frequent, light applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. To avoid exposing the coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical because of the hazard of soil blowing, low annual precipitation, and moderate available water capacity.

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

165-Timmerman coarse sandy loam, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash and alluvium that is mixed with eolian material in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown coarse sandy loam 8 inches thick. The subsoil is pale brown coarse sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and very dark gray loamy coarse sand and coarse sand. The soil is calcareous in the substratum.

Permeability of this Timmerman soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 20 percent Ephrata fine sandy loam, Royal very fine sandy loam, Quincy loamy fine sand, Winchester sand, and Timmerman soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Because of the moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the coarse sand, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIIe, irrigated.

166-Timmerman coarse sandy loam, 2 to 5 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash and alluvium that is mixed with eolian material in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown coarse sandy loam 8 inches thick. The subsoil is pale brown coarse sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and very dark gray loamy coarse sand and coarse sand. The soil is calcareous in the substratum.

Permeability of this Timmerman soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 20 percent Ephrata fine sandy loam, Royal very fine sandy loam, Quincy loamy fine sand, Winchester sand, and Timmerman soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Because of the moderate available water capacity, most crops need frequent applications of irrigation water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the coarse sand, land smoothing operations that include only shallow cuts are advisable.

This map unit is in capability subclass IIIe, irrigated.

167-Timmerman coarse sandy loam, 5 to 10 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash and alluvium that is mixed with eolian material in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown coarse sandy loam 8 inches thick. The subsoil is pale brown coarse sandy loam 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and very dark gray loamy coarse sand and coarse sand. The soil is calcareous in the substratum.

Permeability of this Timmerman soil is moderately rapid to the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 20 percent Timmerman coarse sandy loam, thin solum; Ephrata gravelly sandy loam; Royal very fine sandy loam; Quincy loamy fine sand; and Winchester sand.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion, steepness of slope, and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation systems are best suited to this unit. Because of the moderate available water capacity, most crops need frequent applications of water. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. To avoid exposing the coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, moderate available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

168-Timmerman coarse sandy loam, thin solum, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash and alluvium that is mixed with eolian material in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown coarse sandy loam 8 inches thick. The subsoil is pale brown coarse sandy loam 5 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and very dark gray loamy coarse sand and coarse sand. The soil is calcareous in the substratum.

Permeability of this Timmerman soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 20 percent Timmerman coarse sandy loam, Ephrata gravelly sandy loam, Quincy loamy fine sand, Winchester sand, and Timmerman soils that have slopes of more than 2 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and low available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Because of the depth to coarse sand, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of the low available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, low available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

169-Timmerman coarse sandy loam, thin solum, 2 to 5 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in sandy glacial outwash and alluvium that is mixed with eolian material in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is brown coarse sandy loam 8 inches thick. The subsoil is pale brown sandy loam 5 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and very dark gray loamy coarse sand and coarse sand. The soil is calcareous in the substratum.

Permeability of this Timmerman soil is moderately rapid to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 20 percent Timmerman coarse sandy loam, Ephrata gravelly sandy loam, Quincy loamy fine sand, and Winchester sand.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and low available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Because of the depth to coarse sand, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of the low available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing the coarse sand, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, Sandberg

bluegrass, and big sagebrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, low available water capacity, and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

170-Torrifluvents, nearly level. These very deep, somewhat excessively drained soils are on flood plains. They formed in alluvium. The native vegetation is mainly grasses and forbs. Elevation is 380 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 150 days.

No one profile is typical of Torrifluvents, but one commonly observed in the survey area has a gray very cobbly very fine sandy loam surface layer 2 inches thick. The underlying material to a depth of 60 inches or more is gray, brown, and light olive brown extremely cobbly sand. In places the underlying material is loamy sand or sandy loam and is gravelly or extremely gravelly.

Included in this unit is about 25 percent Burbank loamy fine sand, Ephrata gravelly sandy loam, and Malaga gravelly sandy loam.

Permeability of these Torrifluvents is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is high. These soils are subject to frequent periods of flooding.

This unit is used for wildlife habitat. Use of the unit for grazing and wildlife habitat is limited by the very low production of forage.

This map unit is in capability subclass VIIw, nonirrigated.

171-Touhey very fine sandy loam, 0 to 15 percent slopes. This very deep, well drained soil is on till plains and plateaus. It formed in glacial till that is mixed with loess in the upper part. The native vegetation is mainly grasses and shrubs. Elevation is 1,600 to 2,600 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is brown very fine sandy loam 13 inches thick. The subsoil is yellowish brown gravelly very fine sandy loam 14 inches thick. The substratum to a depth of 60 inches or more is gray gravelly fine sandy loam. Discontinuous lime- and silica-cemented lenses less than 1 /8 inch thick are between depths of 34 and 38 inches. Depth to the cemented lenses ranges from 20 to 36 inches.

Permeability of this Touhey soil is moderate above and below the cemented lenses and moderately slow through them. Available water capacity is moderate. Effective rooting depth is restricted by the cemented lenses at a depth of 20 to 36 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent soils that have a stony or cobbly surface layer and soils that have basalt at a depth of more than 20 inches.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation, moderate available water capacity, and the hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion is reduced if fall grain is seeded early, rows are established at right angles to the prevailing wind, and stubble mulch tillage is used. Stripcropping also reduces soil blowing. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass IIIe, nonirrigated.

172-Umapine silt loam. This very deep, somewhat poorly drained, salt- and sodium-affected soil is on alluvial plains and in basins. It formed in silty alluvium. Slope is 0 to 3 percent. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,600 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 165 days.

Typically, the surface layer is light brownish gray silt loam 9 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray and light gray silt loam. The soil is calcareous throughout.

Permeability of this Umapine soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is ponded, and water erosion is not a hazard. The hazard of soil blowing is moderate. A seasonal high water table fluctuates between depths of 12 and 40 inches in December through April. This soil is subject to occasional periods of flooding in January through April.

Included in this unit is about 5 percent Kittitas silt loam, Esquatzel silt loam, and soils that have a gravelly layer below a depth of 40 inches.

This unit is used as rangeland.

The potential plant community on this unit is mainly basin wildrye, inland saltgrass, alkali cordgrass, and black greasewood. The production of forage is limited by excess salts and wetness. If the range is overgrazed, the proportion of preferred forage plants such as basin wildrye decreases and the proportion of less preferred forage plants such as inland saltgrass and black greasewood increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitation for seeding is excess salts. Proper timing of seeding is critical to the establishment of seedlings. Among the grasses that are suitable for seeding are tall wheatgrass or other salt-tolerant grasses.

This map unit is in capability subclass VIw, nonirrigated.

173-Wahluke very fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on lakebeds and terraces. It formed in lacustrine sediment that has a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 750 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown very fine sandy loam 10 inches thick. The upper 12 inches of the underlying material is light brownish gray very fine sandy loam, the next 22 inches is weakly cemented, discontinuous lenses that crush to light brownish gray very fine sandy loam and silt loam, and the lower part to a depth of 60 inches or more is pale brown very fine sandy loam. The soil is calcareous in the underlying material. Depth to the cemented lenses ranges from 15 to 30 inches.

Permeability of this Wahluke soil is moderately slow. Available water capacity is high. Effective rooting depth is restricted by the cemented lenses at a depth of 15 to 30 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in this unit is about 15 percent Kennewick fine sandy loam, Kennewick silt loam, Royal very fine sandy loam, Warden silt loam, Wahluke soils that have slopes of more than 2 percent, and soils that have a strongly alkaline surface layer.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer and prevents pulverization of the soil, increases the water intake rate and reduces erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. To avoid exposing the calcareous underlying material, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

174-Wahluke very fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on lakebeds

and terraces. It formed in lacustrine sediment with a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 750 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 53 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is pale brown very fine sandy loam 10 inches thick. The upper 12 inches of the underlying material is light brownish gray very fine sandy loam, the next 22 inches is weakly cemented, discontinuous lenses that crush to light brownish gray very fine sandy loam and silt loam, and the lower part to a depth of 60 inches or more is pale brown very fine sandy loam. The soil is calcareous in the underlying material. Depth to the cemented lenses is 15 to 30 inches.

Permeability of this Wahluke soil is moderately slow. Available water capacity is high. Effective rooting depth is restricted by the cemented lenses at a depth of 15 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Included in this unit is about 15 percent Kennewick fine sandy loam, Kennewick silt loam, Royal very fine sandy loam, Warden silt loam, Wahluke soils that have slopes of more than 5 percent, and soils that have a strongly alkaline surface layer.

This unit is used for irrigated cultivated crops, as rangeland, and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of water erosion and soil blowing. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage, which helps to maintain the tilth of the surface layer and prevents pulverization of the soil, increases the water intake rate and reduces erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. To avoid exposing the calcareous underlying material, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and the hazard of soil blowing. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

175-Wanser loamy fine sand, 0 to 5 percent slopes. This very deep, artificially drained, salt- and sodium-affected soil is on flood plains and in basins. It formed in sand derived from mixed sources. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 135 days.

Typically, the surface layer is gray loamy fine sand 8 inches thick. The underlying material to a depth of 60 inches or more is gray fine sand. The soil is calcareous throughout.

Permeability of this Wanser soil is rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. A seasonal high water table fluctuates between depths of 42 and 60 inches in January through June. This soil is subject to occasional periods of flooding in May through November.

Included in this unit is about 30 percent Wanser soils that are poorly drained. Also included is about 15 percent soils that have strata of silt loam in the substratum, noncalcareous soils that are poorly drained, and Quincy loamy fine sand.

This unit is used mainly for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are wetness, excess salts, and the hazards of flooding and soil blowing. Salinity influences the choice of crops. If drainage is maintained and the soil in this unit is leached of excess salts and irrigated, it is suited to small grain, alfalfa, and grasses. Because of the loamy fine sand surface layer, sprinkler, drip, or trickle irrigation is best suited to this unit. Most crops need frequent, light applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces soil blowing. Land smoothing

operations that include deep cuts can expose the salt-and sodium-affected substratum. This map unit is in capability subclass IVe, irrigated.

176-Wanser-Quincy fine sands, 0 to 5 percent slopes. This map unit is on dunes and terraces. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 51 degrees F, and the average frost-free season is about 150 days.

This unit is 55 percent Wanser fine sand and 25 percent Quincy fine sand. The Wanser soil is in basins, and the Quincy soil is on active dunes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit is about 15 percent Aquents, ponded. Also included is about 5 percent soils that are underlain by gravel or sandstone.

The Wanser soil is very deep, poorly drained, and salt- and sodium-affected. It formed in sand derived from mixed sources. Typically, the surface layer is gray fine sand 3 inches thick. The underlying material to a depth of 60 inches or more is gray fine sand.

Permeability of the Wanser soil is rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. A seasonal high water table fluctuates between depths of 6 and 12 inches in May through November. This soil is subject to rare periods of flooding.

The Quincy soil is very deep and somewhat excessively drained. It formed in sand derived from mixed sources. Typically, the surface layer is brown fine sand 9 inches thick. The underlying material to a depth of 60 inches or more is grayish brown fine sand.

Permeability of the Quincy soil is rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland.

The potential plant community on the Wanser soil is mainly inland saltgrass, alkali bluegrass, rush, and sedge. The potential plant community on the Quincy soil is mainly needleandthread, Sandberg bluegrass, big sagebrush, and antelope bitterbrush. The production of forage is limited by the excess salts in the Wanser soil and moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as alkali bluegrass on the Wanser soil and needleandthread on the Quincy soil decreases and the proportion of less preferred forage plants such as inland saltgrass, sedge, and rush on the Wanser soil and rabbitbrush and cheatgrass on the Quincy soil increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical. The main limitations for seeding are excess salts in the Wanser soil, the hazard of soil blowing, and the low annual precipitation.

This map unit is in capability subclass VIIe, nonirrigated.

177-Warden silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces (fig. 7). It formed in lacustrine material that has a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Permeability of this Warden soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Sagehill very fine sandy loam, Sagemoor silt loam, Royal very fine sandy loam, Kennewick silt loam, and Warden soils that have slopes of more than 2 percent.

This unit is used for irrigated cultivated crops, hay, and pasture and as homesites.

This unit has few limitations for irrigated crops. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. If furrow or corrugation irrigation systems are used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Erosion can be minimized by reducing the size of the irrigation stream. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer and also increases the water intake rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This unit is well suited to homesite development and septic tank absorption fields. Dustiness can be a problem on large construction sites. These sites should be disturbed as little as possible. Mulching, fertilization, and irrigation are needed to establish lawn grasses and other small plants.

This map unit is in capability class I, irrigated.

178-Warden silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine material that has a mantle of loess. The native

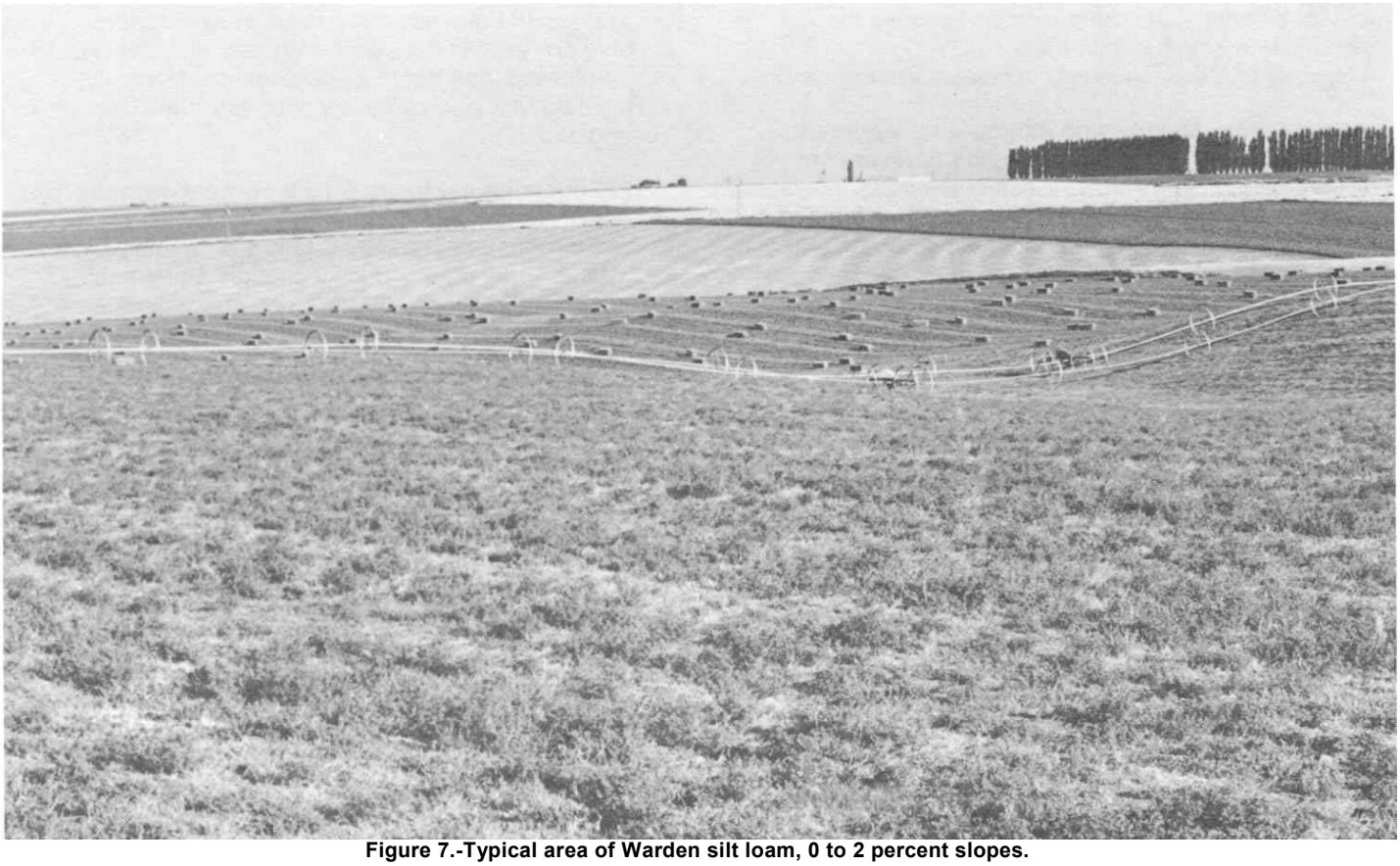

Figure 7.-Typical area of Warden silt loam, 0 to 2 percent slopes.

vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The subsoil is light brownish gray and brown silt loam and very fine sandy loam 20 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and pale brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Warden soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 15 percent Sagehill very fine sandy loam, Sagemoor silt loam, Royal very fine sandy loam, Kennewick silt loam, and Warden soils that have slopes of more than 5 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. If furrow or corrugation irrigation is used, tilling the soil before applying irrigation water can increase the water intake rate; however, it also can increase the risk of erosion. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Erosion can be minimized by reducing the size of the irrigation stream. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop

residue on the surface reduce erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IIe, irrigated.

179-Warden silt loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine material that has a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The subsoil is light brownish gray and brown silt loam and very fine sandy loam 20 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and pale brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Warden soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 15 percent Sagehill very fine sandy loam, Sagemoor silt loam, Royal very fine sandy loam, Kennewick silt loam, and Warden soils that have slopes of more than 10 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. When growing row crops, pitting or forming small basins between the rows reduces runoff and water erosion. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IIIe, irrigated.

180-Warden silt loam, 10 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine material that has a mantle of loess. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 150 days.

Typically, the surface layer is light brownish gray silt loam 6 inches thick. The subsoil is light brownish gray and brown silt loam and very fine sandy loam 20 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and pale brown, stratified silt loam and very fine sandy loam. The soil is calcareous in the substratum.

Permeability of this Warden soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 15 percent Sagehill very fine sandy loam, Sagemoor silt loam, Royal very fine sandy loam, Kennewick silt loam, and Warden soils that have slopes of more than 15 percent.

This unit is used for irrigated cultivated crops, hay, and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of water erosion and steepness of slope. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as small grain, alfalfa, and grasses.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Sprinkler irrigation systems should be managed to avoid excessive water application rates, which cause puddling, impair aeration, and reduce the water intake rate. Returning crop residue to the soil and chiseling, when needed, increase the water intake rate. Minimum tillage helps to maintain the tilth of the surface layer, increases the water intake rate, and reduces water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. Land smoothing operations that include deep cuts can expose the calcareous substratum.

This map unit is in capability subclass IVe, irrigated.

181-Wiehl fine sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in eolian deposits underlain by sandstone and siltstone. The native vegetation is mainly grasses and shrubs. Elevation is 850 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown fine sandy loam 8 inches thick. The subsoil is yellowish brown fine sandy loam 10 inches thick. The substratum is yellowish brown very fine sandy loam 7 inches thick. Sandstone is at a depth of 25 inches. Depth to sandstone and siltstone ranges from 20 to 40 inches.

Permeability of this Wiehl soil is moderate. Available water capacity is moderate. Effective rooting depth is

limited by sandstone or siltstone at a depth of 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 15 percent soils that have semiconsolidated lacustrine deposits at a depth of 10 to 20 inches, soils that have a surface layer and subsoil of silt loam and very fine sandy loam and are underlain by semiconsolidated lacustrine deposits, Royal very fine sandy loam, Sagehill very fine sandy loam, Taunton fine sandy loam, and Wiehl soils that have slopes of more than 2 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation. Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Because of the depth to sandstone and siltstone and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce soil blowing. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing sandstone or siltstone, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the hazard of soil blowing, low annual precipitation, and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

182-Wiehl fine sandy loam, 2 to 5 percent slopes. This moderately deep, well drained soil is on terraces. It formed in eolian deposits underlain by sandstone and siltstone. The native vegetation is mainly grasses and shrubs. Elevation is 850 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown fine sandy loam 8 inches thick. The subsoil is yellowish brown fine sandy loam 10 inches thick. The substratum is yellowish brown very fine sandy loam 7 inches thick. Sandstone is at a depth of 25 inches. Depth to sandstone or siltstone ranges from 20 to 40 inches.

Permeability of this Wiehl soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit is about 25 percent soils that have semiconsolidated lacustrine deposits at a depth of 10 to 20 inches, soils that have a surface layer and subsoil of silt loam and very fine sandy loam and are underlain by semiconsolidated lacustrine deposits, Royal very fine sandy loam, Sagehill very fine sandy loam, Taunton fine sandy loam, and Wiehl soils that have slopes of more than 5 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion and the moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Furrow, corrugation, trickle, drip, or sprinkler irrigation systems are suited to this unit. Corrugation irrigation is suited to close-growing crops. Because of the limited depth to sandstone and siltstone and the moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing sandstone or siltstone, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the hazard of soil blowing, low annual precipitation, and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

183-Wiehl fine sandy loam, 5 to 10 percent slopes. This moderately deep, well drained soil is on terraces. It formed in eolian deposits underlain by sandstone or siltstone. The native vegetation is mainly grasses and shrubs. Elevation is 850 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is brown fine sandy loam 8 inches thick. The subsoil is yellowish brown fine sandy loam 10 inches thick. The substratum is yellowish brown very fine sandy loam 7 inches thick. Sandstone is at a depth of 25 inches. Depth to sandstone or siltstone ranges from 20 to 40 inches.

Permeability of this Wiehl soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Included in this unit is about 25 percent soils that have semiconsolidated lacustrine deposits at a depth of 10 to 20 inches, soils that have a surface layer and subsoil of silt loam and very fine sandy loam and are underlain by semiconsolidated lacustrine deposits, Royal very fine sandy loam, Sagehill very fine sandy loam, Taunton fine sandy loam, and Wiehl soils that have slopes of more than 10 percent.

This unit is used mainly for irrigated cultivated crops. It is also used as rangeland and for irrigated hay and pasture.

If this unit is used for irrigated crops, the main limitations are the hazards of soil blowing and water erosion, steepness of slope, and moderate available water capacity. Many kinds of crops, such as small grain, sugar beets, potatoes, beans, corn, alfalfa, grasses, and peas, can be grown under irrigation.

Because of the steepness of slope, sprinkler, drip, or trickle irrigation is best suited to this unit. Because of the depth to bedrock and the moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which prevents pulverization of the soil. To avoid exposing sandstone or siltstone, land smoothing operations that include only shallow cuts are advisable.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the hazard of soil blowing, low annual precipitation, and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

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

184-Wiehl fine sandy loam, 15 to 35 percent slopes. This moderately deep, well drained soil is on terrace escarpments. It formed in eolian deposits underlain by sandstone and siltstone. The native vegetation is mainly grasses and shrubs. Elevation is 850 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 50 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is brown fine sandy loam 8 inches thick. The subsoil is yellowish brown fine sandy loam 10 inches thick. The substratum is yellowish brown very fine sandy loam 7 inches thick. Sandstone is at a depth of 25 inches. Depth to sandstone or siltstone ranges from 20 to 40 inches.

Permeability of this Wiehl soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very high. The hazard of soil blowing is high.

Included in this unit is about 25 percent soils that have semiconsolidated lacustrine deposits at a depth of 10 to 20 inches, soils that have a surface layer and subsoil of silt loam and very fine sandy loam and are underlain by semiconsolidated lacustrine deposits, Royal very fine sandy loam, Taunton fine sandy loam, and Wiehl soils that have slopes of less than 15 percent.

This unit is used as rangeland and for irrigated pasture and hay.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the

proportion of less preferred forage plants such as big sagebrush, rabbitbrush, and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the hazard of soil blowing, low annual precipitation, and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

If this unit is used for irrigated crops, the main limitations are steepness of slope, the hazards of water erosion and soil blowing, and moderate available water capacity. This unit is poorly suited to row crops, but it is suited to such high-residue, close-growing crops as alfalfa and grasses.

Sprinkler, drip, or trickle irrigation is best suited to this unit because of the steepness of slope. Because of the limited depth to bedrock and moderate available water capacity, most crops need frequent applications of water. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. To avoid exposing bedrock, land smoothing operations that include only shallow cuts are advisable.

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

185-Willis silt loam, 0 to 10 percent slopes. This well drained soil is on terraces and hills. It is moderately deep over a hardpan. The soil formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 130 days.

Typically, the surface layer is grayish brown silt loam 10 inches thick. The subsoil is brown silt loam 8 inches thick. The substratum is pale brown silt loam 5 inches thick. A hardpan is at a depth of 23 inches. The soil is calcareous below a depth of 18 inches. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Willis soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit is about 20 percent soils that have a surface layer and subsoil of very fine sandy loam and fine sandy loam and are underlain by a hardpan at a depth of 20 to 40 inches, Farrell very fine sandy loam, Magallon sandy loam, Stratford loam, and Renslow silt loam.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. The main limitation of the unit for rangeland seeding is the low annual precipitation. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass IIIe, nonirrigated.

186-Winchester sand, 2 to 5 percent slopes. This very deep, excessively drained soil is on hummocky terraces. It formed in alluvial and eolian sand. The native vegetation is mainly grasses and shrubs. Elevation is 500 to 1,800 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 52 degrees F, and the average frost-free season is about 145 days.

Typically, the surface layer is grayish brown sand 8 inches thick. The underlying material to a depth of 60 inches or more is dark gray and gray coarse sand. The soil is calcareous in the lower part of the underlying material.

Permeability of this Winchester soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Included in this unit is about 20 percent Quincy fine sand, Burbank loamy fine sand, and Winchester soils that have slopes of more than 5 percent.

This unit is used as rangeland and for irrigated cultivated crops, hay, and pasture.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, Sandberg bluegrass, and antelope bitterbrush. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread decreases and the proportion of less preferred forage plants such as rabbitbrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding on this unit generally is not practical

because of the hazard of soil blowing, low annual precipitation, and low available water capacity.

If this unit is used for irrigated crops, the main limitations are the hazard of soil blowing and low available water capacity. The main irrigated crops are small grain, potatoes, corn, alfalfa, and grasses for hay and pasture. Low-residue crops can be grown if the unit is adequately protected from soil blowing. Sprinkler, drip, or trickle irrigation is suited to this unit. Because of the low available water capacity, most crops need frequent, light applications of irrigation. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Winter cover crops also protect the soil from erosion. If maintained on the surface, residue from these crops reduces soil blowing in spring. Soil blowing is also reduced by practicing minimum tillage, which reduces pulverization of the soil. To avoid exposing coarse sand, land smoothing operations that include only shallow cuts are advisable.

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

187-Zen silt loam, 0 to 5 percent slopes. This moderately deep, well drained soil is on ridgetops and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,500 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 7 inches thick. The subsoil is brown and yellowish brown silt loam 17 inches thick. The substratum is yellowish brown silt loam 4 inches thick. Basalt is at a depth of 28 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Zen soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit is about 15 percent Renslow silt loam, Bakeoven very cobbly loam, soils that have a gravelly silt loam surface layer and subsoil and are underlain by basalt at a depth of 10 to 40 inches, Zen soils that have slopes of more than 5 percent, and Rock outcrop.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitation is the low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Chiseling or subsoiling the stubble field across the slope reduces runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and threetip sagebrush. The production of forage is limited by the moderate available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass IIIe, nonirrigated.

188-Zen silt loam, 5 to 25 percent slopes. This moderately deep, well drained soil is on ridgetops and hillsides. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,500 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

Typically, the surface layer is grayish brown silt loam 7 inches thick. The subsoil is brown and yellowish brown silt loam 17 inches thick. The substratum is yellowish brown silt loam 4 inches thick. Basalt is at a depth of 28 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of this Zen soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Included in this unit is about 25 percent Renslow silt loam, Bakeoven very cobbly loam, soils that have a gravelly silt loam surface layer and subsoil and have basalt at a depth of 10 to 40 inches, Zen soils that have slopes of less than 5 percent, and Rock outcrop.

This unit is used for nonirrigated crops and as rangeland.

If this unit is used for nonirrigated crops, the main limitations are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Water erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Erosion from the concentrated flow of water is reduced by shaping waterways and seeding them to permanent cover. Chiseling or subsoiling the stubble field across the slope reduces runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and threetip sagebrush. The production of forage is limited by the moderate available water capacity. If the

range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is suited to rangeland seeding. The main limitations for seeding are the low annual precipitation, the hazard of water erosion, and moderate available water capacity. Proper timing of seeding is critical to the establishment of seedlings. This unit can be seeded to adapted grasses.

This map unit is in capability subclass IVe, nonirrigated.

189-Zen-Lickskillet-Ralls complex, 5 to 45 percent slopes. This map unit is on hillsides. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 49 degrees F, and the average frost-free season is about 140 days.

This unit is 35 percent Zen silt loam, 25 percent Lickskillet very cobbly loam, and 25 percent Rails silt loam. The Zen soil is on mid slopes and the Lickskillet and Rails soils are on hillsides.

Included in this unit is about ˜10 percent Bakeoven very cobbly loam, Rails stony silt loam, Kiona cobbly very fine sandy loam, and Renslow silt loam. Also included is about 5 percent soils that have basalt at a depth of 40 to 60 inches.

The Zen soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam 7 inches thick. The subsoil is brown and yellowish brown silt loam 17 inches thick. The substratum is yellowish brown silt loam 4 inches thick. Basalt is at a depth of 28 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Zen soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived dominantly from loess and basalt. Typically, the surface layer is brown very cobbly loam 4 inches thick. The subsoil is brown and yellowish brown very gravelly loam 11 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Lickskillet soil is moderate. Available water capacity is very low. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Rails soil is very deep and well drained. It formed in colluvium derived dominantly from loess and basalt. Typically, the surface layer is grayish brown silt loam 13 inches thick. The subsoil is brown silt loam 31 inches thick. The substratum to a depth of 60 inches or more is brown very gravelly silt loam and pale brown gravelly clay loam. The soil is calcareous in the substratum.

Permeability of the Rails soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and threetip sagebrush. The production of forage is limited by the very low available water capacity of the Lickskillet soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as threetip sagebrush and cheatgrass increases. Because of the steepness of slope, brush control is limited mainly to aerial application of chemicals. Seeding on the Lickskillet soil generally is not practical because of the very cobbly surface layer, steepness of slope, and very low available water capacity. The Zen and Rails soils are limited by steepness of slope. These soils can be seeded to adapted grasses.

This map unit is in capability subclass VIe, nonirrigated.

prime farmland

Prime farmland, as defined by the United States Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It must either be used for producing food or fiber or be available for these uses. It has the soil quality, length of growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is managed properly. Prime farmland produces the highest yields with minimal energy and economic resources, and farming it results in the least disturbance of the environment.

Prime farmland commonly has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and length of growing season and an acceptable level of acidity-or alkalinity. It has few if any rock fragments and is permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods and is not flooded during the growing season. The slope is mainly 0 to 5 percent. Soils that have limitations may qualify for prime farmland if these limitations are overcome by appropriate measures. Onsite investigation is needed to determine the extent of these limitations. For more detailed information on the criteria for prime farmland, consult the local office of the Soil Conservation Service.

The acreage of prime farmland in the county is increasing with the development of irrigation in previously nonirrigated areas. Areas of prime farmland are scattered throughout the county, mainly in general soil map units 1, 2, 4, 7, 9, 10, 15, 16, 19, and 20. Many kinds of crops, such as small grain, potatoes, corn, alfalfa, peas, and orchards, are grown on this land.

A recent trend in land use in some parts of the area has been to convert areas of prime farmland to industrial and urban areas. The loss of prime farmland to these and other uses has made it necessary to farm areas that generally are more erodible, droughty, and difficult to cultivate and are less productive.

The following map units meet the requirements for prime farmland if irrigated. In addition to irrigation, if a soil is considered to be prime farmland only under certain conditions, the conditions are specified in parentheses after the map unit name. The extent of each map unit is given in table 4, the location is given on the detailed soil maps in the back of this publication, and the soil qualities that affect use and management are described in the section "Detailed soil map units." This list does not constitute a recommendation for a particular land use.

2 Adkins very fine sandy loam, 0 to 5 percent slopes
6 Adkins very fine sandy loam, cemented substratum, 0 to 5 percent slopes
15 Bagdad silt loam, 0 to 5 percent slopes
31 Burke silt loam, 0 to 5 percent slopes
34 Cleman very fine sandy loam (where protected from flooding)
37 Ellisforde silt loam, 0 to 5 percent slopes
40 Ephrata fine sandy loam, 0 to 2 percent slopes
41 Ephrata fine sandy loam, 2 to 5 percent slopes
43 Ephrata gravelly sandy loam, 0 to 2 percent slopes
44 Ephrata gravelly sandy loam, 2 to 5 percent slopes
47 Esquatzel silt loam (where protected from flooding)
48 Farrell very fine sandy loam, 0 to 5 percent slopes
54 Hermiston silt loam (where protected from flooding)
56 Kennewick loamy fine sand, 0 to 5 percent slopes
58 Kennewick fine sandy loam, 0 to 2 percent slopes
59 Kennewick fine sandy loam, 2 to 5 percent slopes
62 Kennewick silt loam, 0 to 2 percent slopes
63 Kennewick silt loam, 2 to 5 percent slopes
71 Magallon sandy loam, 0 to 5 percent slopes
80 Neppel fine sandy loam, 0 to 2 percent slopes
81 Neppel fine sandy loam, 2 to 5 percent slopes
82 Neppel very fine sandy loam, 0 to 2 percent slopes
83 Neppel very fine sandy loam, 2 to 5 percent slopes
85 Novark silt loam, 2 to 5 percent slopes
89 Prosser very fine sandy loam, 0 to 2 percent slopes
90 Prosser very fine sandy loam, 2 to 5 percent slopes
104 Renslow silt loam, 0 to 5 percent slopes
109 Ritzville silt loam, 0 to 5 percent slopes
115 Royal very fine sandy loam, 0 to 2 percent slopes
116 Royal very fine sandy loam, 2 to 5 percent slopes
118 Royal very fine sandy loam, cemented substratum, 2 to 5 percent slopes

121 Sagehill very fine sandy loam, 0 to 2 percent slopes
122 Sagehill very fine sandy loam, 2 to 5 percent slopes
125 Sagemoor silt loam, 0 to 2 percent slopes
126 Sagemoor silt loam, 2 to 5 percent slopes
136 Shano silt loam, 0 to 2 percent slopes
137 Shano silt loam, 2 to 5 percent slopes
150 Stratford loam, 0 to 5 percent slopes
152 Taunton fine sandy loam, 0 to 2 percent slopes
153 Taunton fine sandy loam, 2 to 5 percent slopes
156 Taunton silt loam, 0 to 2 percent slopes
157 Taunton silt loam, 2 to 5 percent slopes
165 Timmerman coarse sandy loam, 0 to 2 percent slopes
166 Timmerman coarse sandy loam, 2 to 5 percent slopes
177 Warden silt loam, 0 to 2 percent slopes
178 Warden silt loam, 2 to 5 percent slopes
181 Wiehl fine sandy loam, 0 to 2 percent slopes
182 Wiehl fine sandy loam, 2 to 5 percent slopes
187 Zen silt loam, 0 to 5 percent slopes

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

By Herman R. Gentry, soil scientist, Soil Conservation Service, and A. Irving Dow, soil scientist, Cooperative Extension Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Grant County has about 308,700 acres of nonirrigated cropland and about 325,700 acres of irrigated cropland. The nonirrigated cropland is used mainly for the production of winter wheat. Of the total irrigated cropland, about 15,000 acres is used for pasture; 110,740 acres for row crops; 79,800 acres for close-growing crops; 95,100 acres for hay; 20,060 acres for seed crops; and 5,000 acres for orchards.

The hazards of soil blowing and water erosion are the main limitations for about 90 percent of the cropland. The soils in areas where annual precipitation is 6 to 9 inches are especially subject to soil blowing. Water erosion is a hazard on the irrigated soils that have slopes of more than 2 percent and on other soils that have slopes of more than 5 percent.

Loss of the surface layer through water erosion and soil blowing is a concern for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil or substratum is incorporated into the plow layer. Soil blowing separates the fine soil particles and organic matter from the sandy material, leaving progressively more sand. Loss of the surface layer is of special concern on soils with a layer that limits the thickness of the root zone. Such layers include a hardpan, as in the Burke, Scoon, Taunton, and Willis soils; sand and gravel, as in the Benco, Ephrata, Magallon, Malaga, Neppel, Strat, Stratford, and Timmerman soils; and basalt, as in the Anders, Condon, Prosser, Roloff, and Zen soils. Secondly, erosion of farmland results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and preserves the quality of water available for municipal use, for recreation, and for fish and wildlife. Control of soil blowing and water erosion is essential to the permanent use of soils in farming.

Irrigated cropping systems are used primarily in the southern two-thirds of the county. Irrigation water in this area is supplied mainly by the Columbia Basin Irrigation Project.

Where furrow or corrugation irrigation systems are used, the problem of soil erosion is different from that where sprinkler irrigation is used or the soils are not irrigated. Runoff water from precipitation and sprinkler irrigation attains its maximum rate of flow at the lower end of slopes and produces the most severe erosion in those areas. Under furrow and corrugation irrigation, however, the water has the greatest rate of flow at the initial point of application, or head end, and this is where water erosion is likely to be most severe. Consequently, much of the soil eroded at the head end of furrows or corrugations is frequently deposited before the sediment reaches the tail end.

Furrow and corrugation irrigation systems are suitable where slopes are 5 percent or less, however, they are suitable where slopes of 3 to 5 percent only if close-growing crops are used. To obtain complete wetting of the soil, the stream size must be sufficient to exceed the total water intake rate along the full length of furrows and corrugations. Long furrows and corrugations, especially when they are used on soils that have a high water intake rate, require large and erosive input to transport the water across the field in a reasonable period of time. Most of the erosion takes place at the upper end of the furrows and corrugations because of the larger stream size at the head. Water erosion can be reduced by reducing the length of furrows and corrugations, thus reducing the size of the stream required. The water intake rate decreases after the first irrigation on most soils, especially on soils that have a silt loam or very fine sandy loam surface layer. Consequently, water erosion is reduced if the size of the stream is reduced in subsequent irrigations. Water erosion can also be reduced by adjusting the size of the stream so that it reaches the tail end in a reasonable length of time, and then by cutting the size of the stream back to reduce the volume of tail water to a minimum.

Fewer irrigations of longer duration reduce water erosion under furrow and corrugation irrigation because the greatest amount of erosion takes place very early in the irrigation period; however, if the soil is relatively shallow or sandy, or if shallow-rooted crops are grown, more frequent irrigations of shorter duration are advisable. Water erosion under furrow and corrugation irrigation also can be reduced by using minimum tillage and returning crop residue to the soil. Incorporating crop residue into the surface layer increases the water intake rate and reduces the movement of soil material. Cultivation between irrigations greatly increases water erosion, especially during the initial period of irrigation. Preforming furrows in fall or early in spring allows the soil to settle and consolidate, which reduces water erosion. Erosion is generally less in U-shaped furrows than in V-shaped ones.

Use of filter strips, sediment retention basins, and pump-back systems has no effect on water erosion in the field, but it reduces the amount of sediment that leaves the farm. It is desirable to install pipe, ditch lining, or drop structures in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Fields that have slopes of 5 to 15 percent are suited to sprinkler irrigation only if proper irrigation water management and properly designed systems are used. Some of the deeper soils in the county, most of which are sandy, are suited to sprinkler irrigation even where slopes are as much as 25 percent. When the water application rate is less than the water intake rate of the soils, water erosion is minimal. Sprinkler irrigation systems should be designed to avoid water application rates that cause puddling, which reduces the water intake rate and impairs aeration. Impounding water by using a pitter to form small basins between crop rows and retaining crop residue on the soil surface increase infiltration and reduce water erosion in sprinkler irrigated fields.

Rotating high residue crops with low residue crops on irrigated soils helps to maintain an adequate amount of crop residue on the surface if minimum tillage is used. Growing winter cover crops provides protection from water erosion when high residue crops are not rotated with low residue crops.

Soil blowing is a hazard on most of the soils in the county if furrow and sprinkler irrigation systems are used. Management practices that protect the soil from blowing in spring, such as leaving the surface rough or growing a winter cover crop, may be needed when insufficient crop residue is available after harvest. The amount of residue needed on the soil surface to protect it from blowing varies according to the texture of the surface layer and factors such as field size and surface roughness. Sandy soils such as those of the Burbank and Quincy series need to be planted to a cover crop in spring to protect them from soil blowing. Avoiding tillage when the soils are dry, growing cover crops, using crop residue, and ridging reduce soil blowing. Windbreaks provide limited erosion control benefits on cultivated fields. Cover crops protect orchards and vineyards from soil blowing and water erosion.

Soils such as those of the Warden, Sagehill, and Shano series are suited to a wide variety of crops when irrigated. Suitable crops are wheat, alfalfa, potatoes, beans, peas, and seed crops. Deep soils that have good air drainage are well suited to orchards.

Most of the irrigated soils respond well to nitrogen and phosphorus, and some respond to potassium, sulfur, boron, and zinc. Sandy soils such as those of the Quincy and Burbank series respond to nitrogen best when it is applied with irrigation water, which reduces the loss of nitrogen by leaching. Iron chlorosis is sometimes a problem in orchards that are planted in calcareous soils. On all soils, the amount of fertilizer used should be based on the results of soil tests, on the needs of the crop grown, and on the expected yield.

Drainage systems have been installed on about 60,000 acres of the irrigated land in Grant County. Areas served by the Columbia Basin Project have experienced a substantial rise in the water table, and in some areas a perched water table has developed over drainage barriers. These two conditions have resulted in some areas being affected by drainage problems and salinization of the soils. After a drainage system has been installed and land has been drained, it is necessary to conduct a leaching program. The program needs to be continued to maintain a desirable salt balance. Some soils, such as those of the Kittitas and Saltese series, are naturally wet, so the production of crops on them is not feasible unless artificial drainage is provided.

The wheat-fallow cropping system is used primarily in the Beezley Hills area and in the area east and north of Moses Lake. In these areas small grain is grown in a summer fallow cropping system because the precipitation usually is too low for annual cropping. In the summer fallow system, the soil is kept free of vegetation during one cropping season in order to store additional moisture for the growth of a crop the following season. The crops grown are winter wheat and very minor amounts of spring grain.

The soils used in the summer fallow system respond well to nitrogen. On all the soils the amount of fertilizer used should be based on the results of soil tests, on the amount of moisture available, on the needs of the crop grown, and on the expected yield.

Water erosion is a hazard on the Bagdad, Burke, Condon, Endicott, Farrell, Renslow, Ritzville, Shano, Willis, and Zen soils, and soil blowing is a hazard on the Farrell soils. In years when the snow melts and runoff occurs while the soils are frozen, water erosion can be reduced by seeding fall grain early and using stubble mulch tillage. When the soils are dry in fall, chiseling or subsoiling the stubble field on the contour or across the slope slows the runoff of water and increases the water intake rate. Maintaining an adequate amount of crop residue on the soil surface reduces soil blowing. Practicing minimum tillage prevents soil pulverization and maintains clods that control soil blowing.

The use of divided slope farming, stripcropping, terraces, and diversions helps to control water erosion. Terracing is most practical on deep soils that have uniform slopes. Most of the soils used in fallow cropping systems in areas of more than 9 inches precipitation, except for the Condon, Endicott, Roloff, Willis, and Zen soils, are well suited to terraces and diversions. Condon, Roloff, and Zen soils have basalt at a depth of less than 40 inches; Burke, Endicott, and Willis soils have a hardpan at a depth of less than 40 inches.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown and that good quality irrigation water is uniformly applied as needed.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small or because yield data were not available. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The

numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use. Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or c, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

By Richard H. Barrett, Jr., range conservationist, Soil Conservation Service.

Rangeland in Grant County makes up about 8 percent of the rangeland in the state of Washington. Approximately 1,054,325 acres, or about 63 percent of the total land area in the county, is rangeland.

Livestock operations in the county make extensive use of native rangelands during all or part of the year. Seedings of native rangeland plants and crested wheatgrass provide spring pasture for most livestock operations. In summer, some livestock are grazed on irrigated pasture, while others are trucked to Forest Service and Department of Natural Resources grazing allotments in Okanogan, Ferry, Kittitas, or Chelan Counties. The rest remain on local rangeland.

Late in summer and in fall, rangeland grazing is often supplemented with crop aftermath consisting of wheat and corn stubble or with temporary pastures consisting of turnips, rape, and kale. The southern two-thirds of the county is well suited to winter grazing because it has warmer temperatures and is free of snow. There is a large influx of livestock from surrounding mountainous counties that graze the county's rangelands in winter.

The native vegetation in the county is predominantly of the shrub and grass type. Bluebunch wheatgrass is the main forage species. Where the rangeland is in good to excellent condition, the production of forage ranges from 500 to 800 pounds per acre per year on the more productive range sites. The production potential and plant composition depend on the characteristics of the soils and climate.

The Very Shallow range site, which is in the Channeled Scabland region of the county, is the least productive of the sites. Annual herbage production on this site ranges from 100 to 300 pounds per acre per year.

The most productive sites in the county are along drainage bottoms that, because of the availability of additional moisture and soil nutrients, are capable of producing 4,000 pounds of herbage per acre per year.

Large productive tracts of land once used as rangeland are now used for nonirrigated crop production. With the introduction of irrigation, productive rangeland soils in the low precipitation zones have become intensively cropped areas. Soil blowing and water erosion on cropland are major problems resulting from conversion of rangeland to cropland.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range

plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation-the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil-is listed by common name. Under *composition,* the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.. does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable species, conservation of water, and control of water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. On those soils for which species are not named in this table, the low average annual precipitation or soil droughtiness is considered to be a severe limitation for the establishment or survival of nonirrigated windbreaks; however, a few of the soils may be suitable for windbreaks if they are irrigated. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be

offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

By Ivan L. Lines, Jr., biologist, Soil Conservation Service.

The wildlife native to Grant County includes sage grouse, coyotes, sage thrasher, sage sparrow, blackmailed jackrabbit, burrowing owl, and prairie falcon. Much of the rangeland is characterized by potholes, lakes, wet meadows, and drainageways produced by glacial activity. These areas support a wide variety of herbaceous and woody wetland and riparian vegetation. The wet areas provide habitat for beaver, muskrat, waterfowl, and wading birds, as well as drinking water, food, and cover for terrestrial animals. Wet meadows, for instance, are critical brood rearing areas for sage and sharp-tailed grouse. There are a few scattered stands of ponderosa pine in the northern part of the county. These trees are not dense enough to support woodland wildlife, but they do provide nesting and perching sites for hawks, eagles, and numerous other nongame birds.

Much of the original rangeland in the county has been converted to irrigated or nonirrigated cropland. Where these areas are interspersed with rangeland, riparian, or wetland plant communities or with uncultivated odd areas, they provide habitat for introduced game birds such as pheasants, California quail, and gray partridge. Another introduced species, the chukar partridge, is predominantly a rangeland species that uses cropland, but is not necessarily dependent on it.

The conversion of rangeland to cropland has reduced the amount of habitat available for native rangeland wildlife. Crop production, however, provides an improved food source for waterfowl and introduced upland game birds. The development of an extensive irrigation system with numerous canals, ditches, and reservoirs has greatly increased the quantity of interspersed aquatic, wetland, and riparian habitat.

Populations of resident farmland wildlife have been declining for the past two to three decades. Much of the cover necessary to support farmland wildlife has been inadvertently eliminated by intensified farming. Extensive and excessive cultivation, burning, herbicide spraying, and overgrazing all eliminate critical wildlife cover. The use of numerous pesticides has taken a direct toll on wildlife numbers.

There are numerous opportunities to improve habitat for wildlife in Grant County. The establishment of permanent vegetation on ditchbanks reduces burning and spraying costs and provides cover for wildlife. Windbreaks needed to control soil blowing can provide winter cover, nesting cover, and food for several species. Maintaining permanent plant cover on the corners of areas irrigated by center-pivot sprinkler systems can reduce erosion and provide cover for wildlife.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in

planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are sheep fescue, crested wheatgrass, orchardgrass, smooth brome, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluebunch wheatgrass, Sandberg bluegrass, balsamroot, basin wildrye, lupine, and western yarrow.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are Lombardy poplar, Russian-olive, green ash, and black locust.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, blue spruce, Douglas-fir, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are bitterbrush, rabbitbrush, big sagebrush, Nanking cherry, multiflora rose, and Siberian peashrub.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattail, wild millet, saltgrass, rushes, sedges, and reed canarygrass.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include California quail, pheasant, horned lark, meadowlark, gray partridge, and mourning dove.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include mule deer, sage grouse, meadowlark, black-tailed jackrabbit, and golden eagle.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of

gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill-trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a

high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less

than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (11) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SPSM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection. Where the estimated ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 to 2 percentage points), the classification in the marginal zone has been omitted.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits

extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low,* a change of less than 3 percent; *moderate,* 3 to 6 percent; and *high,* more than 6 percent. *Very high,* greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water. Rock fragments in the soil reduce the K value. The K values expressed in Table 15 have been corrected to reflect the amount of rock fragments in the soil.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Tables 16 and 17 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than

that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table-that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given in table 17 if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (15). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Aridisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Orthid *(Orth,* meaning true, *plus id,* from Aridisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Camborthids *(Camb,* meaning a soil that has an altered, but not an illuvial, B horizon, *plus orthid,* the suborder of the Aridisols that are the most representative, or true).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Xerollic* identifies the subgroup that intergrades the great group. An example is Xerollic Camborthids.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-silty, mixed, mesic Xerollic Camborthids.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (16).* Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (15).* Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Adkins series

The Adkins series consists of very deep and deep, well drained soils on hills. These soils formed mainly in loess. Slope is 0 to 35 percent. Elevation is 1,200 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 150 to 200 days.

These soils are coarse-loamy, mixed, mesic Xerollic Camborthids.

Typical pedon of Adkins very fine sandy loam, cemented substratum, 5 to 10 percent slopes, about 6

miles southwest of George, 1,080 feet north and 1,820 feet west of the southeast corner of sec. 4, T. 17 N., R. 23 E.

A1-0 to 7 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots and few fine roots; mildly alkaline; clear smooth boundary.

B2-7 to 24 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few very fine and fine roots; mildly alkaline; clear wavy boundary.

C1ca-24 to 42 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many spheroidal aggregates of secondary lime 5 to 10 millimeters in diameter; violently effervescent; moderately alkaline; clear wavy boundary.

C2ca-42 to 60 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; common spheroidal aggregates of secondary lime 5 to 10 millimeters in diameter; violently effervescent; strongly alkaline.

Depth to lime and thickness of the solum are 24 to 43 inches. Some pedons are cemented with lime at a depth of 40 to 60 inches.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or loamy fine sand and is neutral or mildly alkaline.

The B horizon has value of 4 or 5 when moist, and it has chroma of 3 or 4 when dry or moist. It is neutral or mildly alkaline.

The C horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 to 4 when dry or moist. It is fine sandy loam or very fine sandy loam and is moderately alkaline or strongly alkaline.

Ahtanum series

The Ahtanum series consists of moderately deep, somewhat poorly drained, salt- and alkali-affected soils on alluvial plains and in basins. These soils formed in silty alluvium. Slope is 0 to 5 percent. Elevation is 1,300 to 2,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 140 days.

These soils are coarse-silty, mixed (calcareous), mesic Typic Duraquolls.

Typical pedon of Ahtanum silt loam about 6 miles north of Soap Lake, 1,040 feet south and 1,800 feet east of the northwest corner of sec. 24, T. 23 N., R. 26 E.

A1-0 to 7 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and medium roots; few very fine tubular pores; violently effervescent; very strongly alkaline; abrupt smooth boundary.

C1-7 to 21 inches; light brownish gray (10YR 6/2) silt loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores; violently effervescent; very strongly alkaline; gradual wavy boundary.

C2casim-21 to 30 inches; light gray (10YR 7/2) hardpan that is weakly cemented with lime and silica, pale brown (10YR 6/3) moist; massive; brittle, hard; very few very fine roots; many very fine tubular pores; some disseminated lime; violently effervescent; strongly alkaline; clear wavy boundary.

C3-30 to 37 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine tubular pores; violently effervescent; moderately alkaline; clear wavy boundary.

C4-37 to 56 inches; pale brown (10YR 6/3) silt loam, very dark grayish brown (10YR 3/2) moist; "massive; soft, friable, slightly sticky and slightly plastic; many very fine and few fine tubular pores; violently effervescent; moderately alkaline; abrupt smooth boundary.

IIC5-56 to 60 inches; light olive gray (5Y 6/2) very fine sandy loam, olive gray (5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; violently effervescent; moderately alkaline.

Depth to the hardpan ranges from 20 to 40 inches. The hardpan is weakly cemented to indurated. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The C horizon has value of 3 to 6 when moist and 5 to 7 when dry, and it has chroma of 2 to 4 when dry.

Anders series

The Anders series consists of moderately deep, well drained soils on benches. These soils formed in loess. Slope is 0 to 10 percent. Elevation is 2,200 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 110 to 140 days.

These soils are coarse-loamy, mixed, mesic Typic Haploxerolls.

Typical pedon of Anders silt loam, 0 to 10 percent slopes, about 4 miles south of Grand Coulee, 120 feet south and 570 feet west of the northeast corner of sec. 1, T. 27 N., R. 30 E.

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; mildly alkaline; abrupt smooth boundary.

B21-8 to 19 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; 5 percent pebbles; mildly alkaline; clear wavy boundary.

B22-19 to 23 inches; brown (10YR 5/3) gravelly silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; common fine tubular pores; 15 percent pebbles; mildly alkaline; abrupt smooth boundary.

IIR-23 inches; basalt.

The thickness of the solum and depth to basalt are 20 to 40 inches. The weighted average content of angular basalt fragments in the solum ranges from 3 to 25 percent.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is neutral or mildly alkaline.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 to 4 when dry or moist. It is silt loam, or gravelly silt loam and is mildly alkaline or moderately alkaline.

Badge series

The Badge series consists of very deep, well drained soils on hillsides. These soils formed in colluvium derived from loess and basalt. Slope is 25 to 55 percent. Elevation is 1,800 to 2,800 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 110 to 150 days.

These soils are loamy-skeletal, mixed, mesic Typic Argixerolls.

Typical pedon of a Badge cobbly loam in an area of Badge-Bakeoven complex, 25 to 55 percent slopes, about 1/4 mile south of Grand Coulee, 1,500 feet south and 1,800 feet west of the northeast corner of sec. 14, T. 28 N., R. 30 E.

A11-0 to 9 inches; dark grayish brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; moderate very fine and fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many fine pores; 10 percent pebbles and 15 percent cobbles; mildly alkaline; gradual wavy boundary.

A12-9 to 16 inches; dark brown (10YR 4/3) very cobbly loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores and many medium pores; 20 percent pebbles and 30 percent cobbles; mildly alkaline; clear smooth boundary.

B21t-16 to 25 inches; yellowish brown (10YR 5/4) extremely cobbly loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; thin patchy clay films on faces of peds; common very fine roots; many very fine pores; 30 percent pebbles and 35 percent cobbles; mildly alkaline; clear smooth boundary.

B22t-25 to 33 inches; yellowish brown (10YR 5/4) very cobbly loam, dark brown (10YR 4/3) moist; moderate, medium subangular blocky structure; slightly hard, friable, sticky and plastic; thin patchy clay films on faces of peds; few very fine roots; many very fine pores; 25 percent pebbles and 25 percent cobbles; mildly alkaline; clear smooth boundary.

C1-33 to 60 inches; yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 4/3) moist; massive; loose, slightly sticky and slightly plastic; few very fine roots; many very fine pores; 40 percent pebbles and 15 percent cobbles; mildly alkaline.

The control section averages 35 to 70 percent angular basalt fragments.

The A horizon has value of 4 or 5 when dry.

The B horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when moist. It is very gravelly clay loam, extremely gravelly silt loam, very cobbly loam, or extremely cobbly loam.

The C horizon has value of 5 or 6 when dry, and it has chroma of 2 or 3 when moist. It is very cobbly silt loam, extremely gravelly loam, very gravelly loam, or extremely cobbly loam.

Bagdad series

The Bagdad series consists of very deep, well drained soils on hills. These soils formed in loess. Slope is 0 to 20 percent. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 110 to 140 days.

These soils are coarse-silty, mixed, mesic Calcic Argixerolls.

Typical pedon of Bagdad silt loam, 5 to 20 percent slopes, about 5 miles north of Hartline, 50 feet south and 200 feet west of the northeast corner of sec. 12, T. 26 N., R. 29 E.

Ap-0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable, slightly

sticky and slightly plastic; many roots; many very fine pores; neutral; abrupt smooth boundary.
A3-9 to 13 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine tubular pores; neutral, clear smooth boundary.
B1-13 to 17 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine tubular pores; neutral; clear smooth boundary.
B21t-17 to 25 inches; light yellowish brown (10YR 6/4) silt loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common roots; many fine and few medium tubular pores; thin continuous siliceous coatings on vertical faces of peds; neutral; gradual wavy boundary.
B22t-25 to 36 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common roots; many fine and few coarse tubular pores; thin patchy clay films and thin continuous siliceous coatings on vertical faces of peds; mildly alkaline; clear wavy boundary.
C1ca-36 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; few roots; many fine tubular pores; strongly effervescent; carbonate material segregated in pores and root channels; moderately alkaline.

The solum is 32 to 43 inches thick. The control section is less than 18 percent clay. Depth to lime ranges from 32 to 43 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. It is slightly acid or neutral.

The B horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4 when dry or moist. It is neutral or mildly alkaline.

The Cca horizon has value of 5 to 7 when dry, and it has chroma of 3 or 4 when dry or moist. It is moderately alkaline or strongly alkaline.

Bakeoven series

The Bakeoven series consists of very shallow, well drained soils on ridgetops, hillsides, and benches. These soils formed in loess and in material derived from basalt. Slope is 0 to 55 percent. Elevation is 550 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 110 to 180 days.

These soils are loamy-skeletal, mixed, mesic Lithic Haploxerolls.

Typical pedon of Bakeoven very cobbly loam, 0 to 35 percent slopes, about 1/2 mile west of Ephrata, 60 feet east and 1,590 feet south of the northwest corner of sec. 16, T. 21 N., R. 26 E.

A1-0 to 4 inches; brown (10YR 5/3) very cobbly loam, dark brown (10YR 3/3) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common coarse vesicular pores; 30 percent pebbles and 25 percent cobbles; mildly alkaline; abrupt smooth boundary.
B2-4 to 7 inches; yellowish brown (10YR 5/4) very gravelly loam, dark yellowish brown (10YR 3/4) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few fine tubular pores; common thin clay films on faces of peds; 35 percent pebbles and 15 percent cobbles; mildly alkaline; abrupt irregular boundary.
IIR-7 inches; basalt.

The thickness of the solum and depth to basalt are 4 to 12 inches. The solum is neutral or mildly alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. The B horizon has value of 5 or 6 when dry and 2 to 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very gravelly loam or very cobbly clay loam.

Benco series

The Benco series consists of very deep, well drained soils on terraces. These soils formed in gravelly glacial outwash that is mixed with loess in the upper part. Slope is 0 to 15 percent. Elevation is 1,900 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 110 to 140 days.

These soils are loamy-skeletal, mixed, mesic Typic Haploxerolls.

Typical pedon of Benco stony loam, 0 to 15 percent slopes, about 4 miles south of Grand Coulee, 400 feet south and 1,500 feet west of the northeast corner of sec. 2, T. 27 N., R. 30 E.

A1-0 to 8 inches; grayish brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; 10 percent pebbles, 20 percent cobbles, and 2 percent stones; neutral; clear wavy boundary.
B2-8 to 23 inches; pale brown (10YR 6/3) very gravelly loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots;

35 percent pebbles and 15 percent cobbles; neutral; abrupt wavy boundary.
C-23 to 60 inches; gray (10YR 5/1) extremely gravelly coarse sand, very dark gray (10YR 3/1) moist; single grain; loose; 70 percent pebbles and 20 percent cobbles; white coating of silica on the lower side of some rock fragments; neutral.

The thickness of the solum is 16 to 28 inches. The control section is more than 35 percent rock fragments. The A horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is gravelly or stony. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It is very gravelly loam, very cobbly silt loam, or very cobbly loam. The C horizon is extremely gravelly coarse sand or very gravelly sand.

Burbank series

The Burbank series consists of very deep, excessively drained soils on terraces. These soils formed in gravelly glacial outwash that has a mantle of eolian sand. Slope is 0 to 15 percent. Elevation is 400 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 53 degrees F, and the average annual frost-free season is 140 to 200 days.

These soils are sandy-skeletal, mixed, mesic Xeric Torriorthents.

Typical pedon of Burbank loamy fine sand, 0 to 15 percent slopes, about 3/4 mile southeast of Mattawa, 240 feet north and 150 feet east of the southwest corner of sec. 1, T. 14 N., R. 23 E.

A1-0 to 4 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; single grain; loose; many very fine roots; 10 percent pebbles; mildly alkaline; gradual wavy boundary.
C1-4 to 13 inches; yellowish brown (10YR 5/4) loamy fine sand, dark brown (10YR 4/3) moist; single grain; loose; few fine roots; 10 percent pebbles; mildly alkaline; gradual wavy boundary.
C2-13 to 19 inches; yellowish brown (10YR 5/4) gravelly loamy fine sand, dark brown (10YR 4/3) moist; single grain; loose; few fine roots; 15 percent pebbles; mildly alkaline; abrupt wavy boundary.
C3-19 to 23 inches; pale brown (10YR 6/3) gravelly loamy sand, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; 30 percent pebbles; moderately alkaline; abrupt wavy boundary.
C4-23 to 60 inches; gray (10YR 5/1) extremely gravelly sand, very dark gray (10YR 3/1) moist; single grain; loose; 65 percent pebbles and 10 percent cobbles; slightly effervescent on bottom of pebbles; moderately alkaline.

The control section averages 45 to 70 percent basalt fragments. It dominantly is loamy sand or loamy fine sand in the upper part and sand or coarse sand in the lower part. The profile has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 to 4 when dry or moist. The A horizon is loamy fine sand, stony loamy sand, very cobbly loamy sand, or very bouldery loamy sand.

Burke series

The Burke series consists of moderately deep, well drained soils on hills. These soils formed in loess. Slope is 0 to 15 percent. Elevation is 1,400 to 2,200 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 180 days.

These soils are coarse-silty, mixed, mesic Xerollic Durorthids.

Typical pedon of Burke silt loam, 5 to 15 percent slopes, about 11 miles east of Moses Lake, 771 feet south and 2,210 feet east of the northwest corner of sec. 23, T. 19 N., R. 30 E.

A1-0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; mildly alkaline; abrupt smooth boundary.
C1ca-6 to 23 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive, slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine pores; 5 percent fragments that are cemented with lime and silica; common spheroidal aggregates of secondary lime; slightly effervescent; moderately alkaline; clear wavy boundary.
C2ca-23 to 34 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots in fractures; many very fine pores; 5 percent fragments that are cemented with lime and silica; secondary lime in pores and irregular fractures; strongly effervescent; moderately alkaline; abrupt smooth boundary.
C3casim-34 inches; duripan that is cemented with lime and silica.

The depth to the duripan is 20 to 40 inches. The duripan is 6 inches to several feet thick. The control section is silt loam or very fine sandy loam.

The profile has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. The A horizon is mildly alkaline or moderately alkaline. The C horizon is moderately alkaline or strongly alkaline.

Chard series

The Chard series consists of very deep, well drained soils on terraces. These soils formed in glaciofluvial deposits that have a mantle of loess. Slope is 5 to 15 percent. Elevation is 2,300 to 2,500 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 110 to 140 days.

These soils are coarse-loamy, mixed, mesic Calcic Haploxerolls.

Typical pedon of Chard very fine sandy loam, 5 to 15 percent slopes, about 5 miles south of Grand Coulee, 399 feet east and 30 feet north of the southwest corner of sec. 1, T. 27 N., R. 30 E.

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline; abrupt smooth boundary.

A12-8 to 13 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure and weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

B2-13 to 26 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; moderately alkaline; clear wavy boundary.

C1-26 to 38 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine tubular pores; moderately alkaline; clear wavy boundary.

IIC2ca-38 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common spheroidal aggregates of secondary lime; strongly effervescent; strongly alkaline.

The solum is 20 to 30 inches thick. Depth to secondary lime ranges 24 to 42 inches. The control section is less than 5 percent coarse fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is neutral or mildly alkaline.

The B horizon has value of 4 or 5 when dry. It is very fine sandy loam, loam, or silt loam and is neutral or moderately alkaline.

The IIC horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is fine sandy loam or sandy loam and is moderately alkaline or strongly alkaline.

Cleman series

The Cleman series consists of very deep, well drained soils on alluvial plains. These soils formed in sandy alluvium. Slope is 0 to 2 percent. Elevation is 400 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

These soils are coarse-loamy, mixed, mesic Torrifluventic Haploxerolls.

Typical pedon of Cleman very fine sandy loam about 7 miles northwest of Ephrata, 200 feet south and 1,350 feet east of the northwest corner of sec. 4, T. 22 N., R. 25 E.

Ap-O to 9 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; few very fine tubular pores; neutral; abrupt smooth boundary.

C1-9 to 22 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few very fine tubular pores; mildly alkaline; clear wavy boundary.

C2-22 to 33 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few very fine tubular pores; mildly alkaline; abrupt wavy boundary.

C3-33 to 46 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; few very fine roots; few very fine tubular pores; mildly alkaline; clear wavy boundary.

C4ca-46 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; single grain; loose; few very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline.

The control section is 0 to 5 percent coarse fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when moist or dry. It is neutral or mildly alkaline.

The C horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 to 4 when moist or dry. Above a depth of 40 inches, the C horizon is stratified with silt loam to loamy fine sand and is neutral or mildly alkaline. Below a depth of 40 inches, it is stratified with silt loam to sand, is 0 to 15 percent rock fragments, and is mildly alkaline or moderately alkaline.

Condon series

The Condon series consists of moderately deep, well drained soils on hillsides. These soils formed in loess.

Slope is 5 to 25 percent. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 111 to 150 days.

These soils are fine-silty, mixed, mesic Typic Haploxerolls.

Typical pedon of Condon silt loam, 5 to 25 percent slopes, about 6 miles northeast of Hartline, 1,056 feet east and 2,900 feet south of the northwest corner of sec. 12, T. 26 N., R. 30 E.

Ap-0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many fine vesicular pores; neutral; abrupt smooth boundary.

B21-9 to 12 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; many fine roots; many fine tubular pores; neutral; abrupt smooth boundary.

B22-12 to 27 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 3/4) moist; strong fine and medium angular blocky structure; hard, friable, sticky and plastic; thin continuous clay films on faces of peds and in pores; common very fine roots; many fine and medium tubular pores; neutral; abrupt irregular boundary.

IIR-27 inches; basalt.

Thickness of the solum and depth to basalt are 20 to 40 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is slightly acid or neutral. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 to 4 when dry or moist. It is neutral or mildly alkaline.

Ekrub series

The Ekrub series consists of shallow, somewhat excessively drained soils on terraces. These soils formed in eolian sand. Slope is 0 to 25 percent. Elevation is 800 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 150 to 200 days.

These soils are sandy-skeletal, mixed, mesic, shallow Xerollic Durorthids.

Typical pedon of Ekrub fine sand, 0 to 25 percent slopes, about 7 miles southwest of George, 2,400 feet north and 400 feet west of the southeast corner of sec. 16, T. 17 N., R. 23 E.

A1-0 to 3 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grain; loose; many very fine roots; 5 percent pebbles that are cemented with lime and silica; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1ca-3 to 12 inches; light grayish brown (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common very fine roots; 5 percent pebbles that are cemented with lime and silica; strongly effervescent; strongly alkaline; clear wavy boundary.

C2ca-12 to 18 inches; light grayish brown (10YR 6/2) very gravelly fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common very fine roots; 55 percent pebbles that are cemented with lime and silica; violently effervescent; strongly alkaline; abrupt *wavy* boundary.

IIC3casim-18 inches; white (10YR 8/1) duripan that is cemented with lime and silica; massive; extremely hard, extremely firm; violently effervescent.

The depth to the duripan ranges from 14 to 20 inches. The control section is sand, fine sand, or loamy fine sand and is 35 to 60 percent coarse fragments. The A horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3 when dry or moist. The C horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 1 to 3 when dry or moist.

Ellisforde series

The Ellisforde series consists of very deep, well drained soils on terraces. These soils formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. Elevation is 1,300 to 1,600 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 160 days.

These soils are coarse-silty, mixed, mesic Calciorthidic Haploxerolls.

Typical pedon of Ellisforde silt loam, 5 to 15 percent slopes, about 1 1/2 miles southwest of Electric City, 2,000 feet south of the northeast corner of sec. 20, T. 28 N., R. 30 E.

A1-0 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; few fine tubular pores; many fine roots; neutral; abrupt smooth boundary.

B2-9 to 21 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak very coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; few fine tubular pores; mildly alkaline; clear wavy boundary.

C1ca-21 to 27 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) moist; soft, very friable, nonsticky and nonplastic; common roots; many fine tubular pores; few spheroidal aggregates

of secondary lime; strongly effervescent; moderately alkaline; clear wavy boundary.

IIC2ca-27 to 31 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; secondary lime in pores and seams; violently effervescent; strongly alkaline; abrupt wavy boundary.

IIC3-31 to 60 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; strong fine platy structure; hard, friable, slightly sticky and slightly plastic; few fine roots; violently effervescent; strongly alkaline.

The solum is 15 to 30 inches thick. Depth to lime ranges from 20 to 36 inches. The control section is less than 18 percent clay and less than 5 percent rock fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is silt loam or very fine sandy loam and is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 3 or 4 when moist, and chroma is 2 or 3 when dry or moist.

The IIC horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or 3 when dry or moist. It dominantly is stratified silt loam, but includes strata less than 1 inch thick of very fine sandy loam or fine sandy loam in some pedons.

Endicott series

The Endicott series consists of moderately deep, well drained soils on hills. These soils formed in loess. Slope is 7 to 20 percent. Elevation is 2,300 to 2,700 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 110 to 140 days.

These soils are coarse-silty, mixed, mesic Haplic Durixerolls.

Typical pedon of an Endicott silt loam in an area of Bagdad-Endicott silt loams, 7 to 20 percent slopes, about 2 miles northeast of Hartline, 20 feet north and 600 feet east of the southwest corner of sec. 23, T. 26 N., R. 29 E.

Ap-0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky to granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many very fine pores; mildly alkaline; abrupt smooth boundary.

B21t-7 to 11 inches; brown (10YR 5/2) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common roots; many very fine pores and few fine pores; moderately alkaline; clear wavy boundary.

B22t-11 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common roots; many very fine pores and few fine pores; moderately alkaline; abrupt wavy boundary.

C1ca-21 to 25 inches; white (10YR 8/2) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; common very fine pores and few fine pores; friable impure masses of secondary lime and few aggregates of secondary lime; violently effervescent; strongly alkaline; clear smooth boundary.

C2casim-25 inches; duripan that is cemented with lime and silica.

The depth to the duripan is 20 to 40 inches. The solum is 20 to 30 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is neutral or mildly alkaline.

The B2 horizon has value of 5 or 6 when dry, and it has chroma of 3 or 4 when dry or moist. It is mildly alkaline or moderately alkaline.

The C horizon has value of 7 or 8 when dry and 6 or 7 when moist, and it has chroma of.2 or 3 when dry or moist.

Entiat series

The Entiat series consists of shallow, well drained soils on hillsides. These soils formed in loess and in material derived from granodiorite and granite. Slope is 25 to 65 percent. Elevation is 1,500 to 2,500 feet. The average annual precipitation is about 11 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 155 days.

These soils are loamy-skeletal, mixed, mesic, shallow Aridic Haploxerolls.

Typical pedon of an Entiat gravelly fine sandy loam in an area of Entiat-Rock outcrop complex, 25 to 65 percent slopes, about 3 1/2 miles southwest of Electric City, 1,590 feet south and 300 feet east of the northwest corner of sec. 6, T. 27 N., R. 30 E.

A1-0 to 4 inches; dark grayish brown (10YR 4/2) gravelly fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine continuous pores; 20 percent fine pebbles; mildly alkaline; clear smooth boundary.

A3-4 to 9 inches; brown (10YR 5/3) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few fine continuous pores; 30 percent fine pebbles; mildly alkaline; clear smooth boundary.

B2-9 to 15 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine continuous pores; 50 percent pebbles and 5 percent cobbles; mildly alkaline; abrupt wavy boundary.

Cr-15 inches; decomposing granodiorite.

The depth to granodiorite is 14 to 20 inches. The control section averages 45 to 60 percent granodiorite fragments. It is neutral or mildly alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. The B horizon has value of 4 to 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist.

Ephrata series

The Ephrata series consists of very deep, well drained soils on terraces. These soils formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 15 percent. Elevation is 500 to 1,300 feet. The average annual precipitation Js about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 190 days.

These soils are coarse-loamy over sandy or sandy-skeletal, mixed, mesic Xerollic Camborthids.

Typical pedon of Ephrata fine sandy loam, 0 to 2 percent slopes (fig. 8), about 3/4 mile east of Moses Lake, 549 feet south and 1,000 feet west of the northeast corner of sec. 24, T. 19 N., R. 28 E.

Ap-0 to 9 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; 10 percent fine pebbles; mildly alkaline; abrupt smooth boundary.

B21-9 to 16 inches; pale brown (10YR 6/3) gravelly fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 15 percent pebbles; mildly alkaline; clear wavy boundary.

B22-16 to 23 inches; pale brown (10YR 6/3) gravelly fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 20 percent pebbles and 5 percent cobbles; mildly alkaline; clear *wavy* boundary.

C1ca-23 to 25 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 5/3) moist; massive; slightly hard, firm, nonsticky and nonplastic; few roots; common very fine tubular

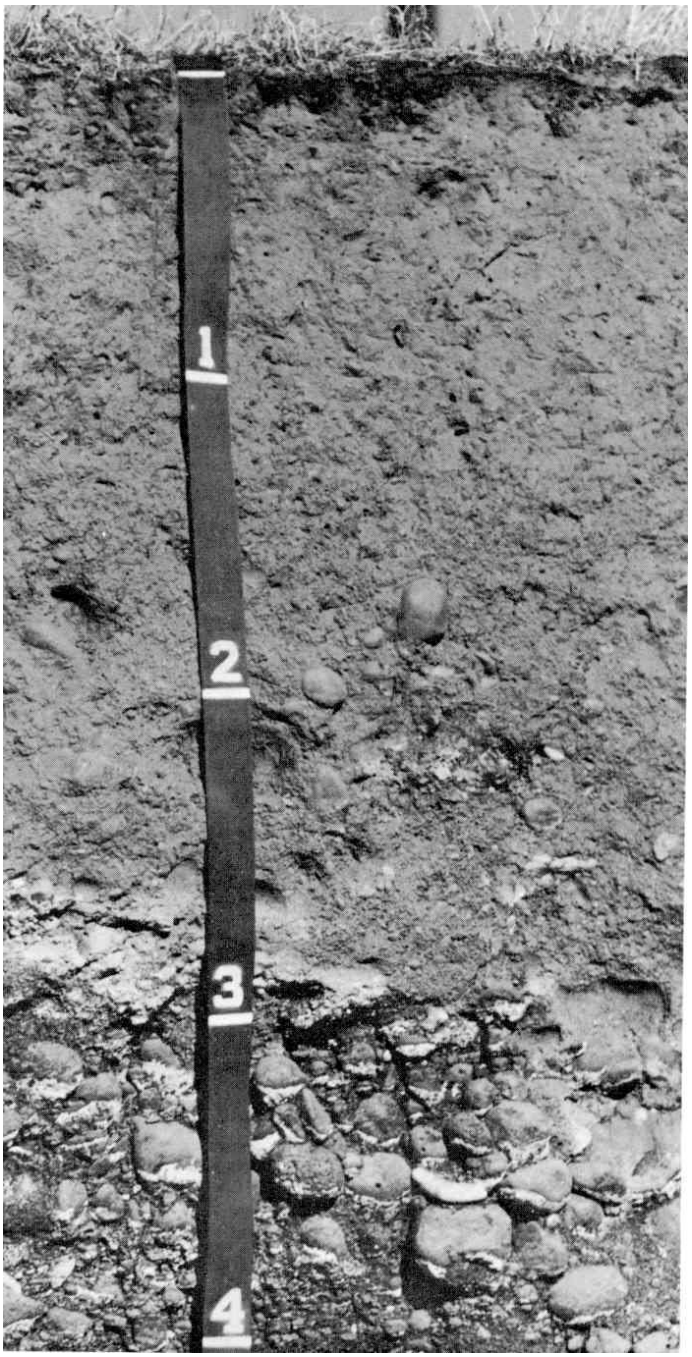

Figure 8.-Profile of Ephrata fine sandy loam, 0 to 2 percent slopes.

pores; 30 percent pebbles and 10 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

IIC2-25 to 60 inches; gray (10YR 5/1) extremely gravelly coarse sand, very dark gray (10YR 3/1) moist; single grain; loose; 55 percent pebbles and 15 percent cobbles; coatings of lime and silica on undersides of pebbles and cobbles; strongly effervescent; moderately alkaline.

Thickness of the solum ranges from 16 to 26 inches. Depth to the IIC horizon ranges from 20 to 40 inches. The control section averages 5 to 35 percent coarse fragments in the upper part and 50 to 75 percent in the lower part.

The A horizon has value of 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry. It is fine sandy loam or gravelly sandy loam.

The B horizon has value of 5 or 6 when dry, and it has chroma of 2 or 3 when dry or moist. It is fine sandy loam, gravelly fine sandy loam, or gravelly sandy loam and is mildly alkaline or moderately alkaline.

The C horizon has value of 5 or 6 when dry, and it has chroma of 2 or 3 when dry or moist.

The IIC horizon is very cobbly coarse sand, very gravelly coarse sand, or extremely gravelly coarse sand.

Esquatzel series

The Esquatzel series consists of very deep, well drained soils on alluvial plains. These soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 600 to 2,000 feet. The average annual precipitation is about 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 150 days.

These soils are coarse-silty, mixed, mesic Torrifluventic Haploxerolls.

Typical pedon of Esquatzel silt loam about 13 miles east of Moses Lake, 1,050 feet south and 1,500 feet west of the northeast corner of sec. 1, T. 18 N., R. 30 E.

A1-0 to 7 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine tubular pores; mildly alkaline; clear wavy boundary.

C1-7 to 31 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; moderately alkaline; clear wavy boundary.

C2-31 to 52 inches; brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; few very fine tubular pores; slightly effervescent; moderately alkaline; clear wavy boundary.

C3-52 to 60 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; very few fine roots; very few fine tubular pores; slightly effervescent; moderately alkaline.

Depth to lime ranges from 12 to 40 inches. The A horizon has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline. The C horizon has value of 5 or 6 when dry. It is mildly alkaline or moderately alkaline.

Farrell series

The Farrell series consists of very deep, well drained soils on terraces. These soils formed in glaciofluvial deposits that have a mantle of loess. Slope is 0 to 10 percent. Elevation is 1,300 to 1,800 feet. The average annual precipitation is about 11 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 155 days.

These soils are coarse-loamy, mixed, mesic Calciorthidic Haploxerolls.

Typical pedon of Farrell very fine sandy loam, 0 to 5 percent slopes, about 7 miles northwest of Ephrata, 20 feet north and 2,460 feet west of the southeast corner of sec. 4, T. 22 N., R. 25 E.

Ap-0 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline; clear wavy boundary.

B2-8 to 20 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots and few fine and medium roots; common very fine tubular pores; moderately alkaline; clear wavy boundary.

IIC1ca-20 to 40 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; common spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIC2ca-40 to 54 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; many spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIC3ca-54 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; few spheroidal aggregates of

secondary lime; violently effervescent; strongly alkaline.

Thickness of the solum is 15 to 30 inches. Depth to lime is 15 to 40 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam, loam, or silt loam and is mildly alkaline or moderately alkaline.

The IIC horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is stratified with coarse sandy loam, fine sandy loam, very fine sandy loam, and silt loam and is moderately alkaline or strongly alkaline.

Finley series

The Finley series consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in gravelly alluvium. Slope is 0 to 15 percent. Elevation is 600 to 1,500 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 210 days.

These soils are loamy-skeletal, mixed, mesic Xerollic Camborthids.

Typical pedon of a Finley cobbly very fine sandy loam in an area of Taunton-Finley complex, 0 to 10 percent slopes, about 5 miles northeast of Quincy, 2,160 feet south and 1,600 feet east of the northwest corner of sec. 32, T. 21 N., R. 25 E.

Ap-0 to 8 inches; brown (10YR 5/3) cobbly very fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; many fine roots; many fine tubular pores; 20 percent cobbles and 10 percent pebbles; mildly alkaline; abrupt *wavy* boundary.

B21-8 to 16 inches; brown (10YR 5/3) extremely cobbly fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; 40 percent cobbles and 30 percent pebbles; mildly alkaline; clear wavy boundary.

B22-16 to 23 inches; brown (10YR 5/3) very cobbly sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; common fine tubular pores; 30 percent cobbles and 20 percent pebbles; mildly alkaline; clear wavy boundary.

IIC3ca-23 to 60 inches; light brownish gray (10YR 6/2) extremely gravelly loamy sand, dark brown (10YR 4/3) moist; single grain; loose; lenses of very gravelly coarse sand; few fine roots; 20 percent cobbles -and-50-percent-pebbles; common aggregates of secondary lime; strongly effervescent; moderately alkaline.

Depth to lime is 14 to 40 inches or more. Depth to the IIC horizon is 20 to 40 inches. The control section averages 50 to 70 percent coarse fragments.

The A horizon has value of 5 to 7 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. The upper 7 inches, where mixed, is less than 1 percent organic matter. The A horizon is gravelly fine sandy loam, very cobbly fine sandy loam, cobbly very fine sandy loam, or very fine sandy loam.

The B horizon has value of 5 to 7 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very gravelly fine sandy loam, extremely cobbly fine sandy loam, very cobbly sandy loam, or extremely gravelly sandy loam. The B horizon is mildly alkaline or moderately alkaline.

The IIC horizon is very gravelly loamy sand, very cobbly loamy sand, extremely gravelly loamy sand, or extremely cobbly sand.

Hermiston series

The Hermiston series consists of very deep, well drained soils on alluvial plains. These soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 1,600 to 2,300 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 110 to 140 days.

These soils are coarse-silty, mixed, mesic Cumulic Haploxerolls.

Typical pedon of Hermiston silt loam about 6 miles south of Grand Coulee, 300 feet south and 50 feet east of the northwest corner of sec. 14, T. 27 N., R. 30 E.

Ap-0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; massive and weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; neutral; abrupt smooth boundary.

A11-8 to 11 inches; brown (10YR 5/3) very fine sandy loam, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; neutral; abrupt smooth boundary.

A12-11 to 21 inches; brown (10YR 5/3) silt loam, very dark grayish-brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; neutral; clear wavy boundary.

C1-21 to 28 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; mildly alkaline gradual smooth boundary.

C2ca-28 to 38 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; continuous thin clay films on faces of peds; secondary lime in pores; strongly effervescent; strongly alkaline; gradual smooth boundary.

C3ca-38 to 47 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; strongly effervescent in pores; moderately alkaline; clear smooth boundary.

C4ca-47 to 60 inches; pale brown (10YR 6/3) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine and few medium tubular pores; violently effervescent; strongly alkaline.

Depth to lime ranges from 15 to 30 inches. The A horizon has value of 4 or 5 when dry. It is 20 to 30 inches thick and is neutral to moderately alkaline. The C horizon has value of 3 or 4 when moist. It has lenses of very fine sand or volcanic ash and is mildly alkaline to strongly alkaline.

Hezel series

The Hezel series consists of very deep, somewhat excessively drained soils on terraces. These soils formed in lacustrine deposits that have a mantle of eolian sand. Slope is 0 to 10 percent. Elevation is 650 to 1,500 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 150 to 200 days.

These soils are sandy over loamy, mixed, nonacid, mesic Xeric Torriorthents.

Typical pedon of Hezel loamy fine sand, 0 to 10 percent slopes, about 3 miles southeast of Quincy, 1,285 feet east and 1,600 feet north of the southwest corner of sec. 35, T. 20 N., R. 24 E.

Ap-0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; many very fine roots; mildly alkaline; clear smooth boundary.

C1-8 to 16 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common very fine roots; mildly alkaline; clear smooth boundary.

C2-16 to 26 inches; brown (10YR 5/3) loamy sand, brown (10YR 4/3) moist; single grain; loose; common very fine roots; slightly effervescent; moderately alkaline; clear smooth boundary.

IIC3ca-26 to 37 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, slightly sticky and slightly plastic; finely stratified with silt; common very fine roots; secondary lime in seams and lenses of secondary lime; strongly effervescent; strongly alkaline; clear smooth boundary.

IIC4ca-37 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; hard, firm, nonsticky and nonplastic; few very fine roots; secondary lime in seams; strongly effervescent; strongly alkaline.

Depth to lime ranges from 10 to 30 inches. Depth to the IIC horizon is 15 to 36 inches.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is neutral to moderately alkaline.

The C horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is loamy fine sand, loamy sand, or fine sand and is neutral to moderately alkaline.

The IIC horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 1 to 3 when dry or moist. It is stratified silt loam, very fine sandy loam, loamy very fine sand, and fine sandy loam and has thin lenses of fine sand. The IIC horizon is mildly alkaline to strongly alkaline.

Kennewick series

The Kennewick series consists of very deep, well drained soils on terraces. These soils formed in lacustrine deposits. Slope is 0 to 25 percent. Elevation is 650 to 1,400 feet. The average annual precipitation is about 7 inches, the average air temperature is about 53 degrees F, and the average frost-free season is 140 to 210 days.

These soils are coarse-silty, mixed (calcareous), mesic Xeric Torriorthents.

Typical pedon of Kennewick silt loam, 2 to 5 percent slopes, about 6 miles east of Mattawa, 2,100. feet south and 900 feet east of the northwest corner of sec. 36 T. 15 N., R. 24 E.

Ap-0 to 9 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1-9 to 20 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; finely stratified with silt; few very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline; gradual wavy boundary.

C2ca-20 to 30 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly

hard, friable, slightly sticky and slightly plastic; finely stratified with silt; few very fine roots; few very fine tubular pores; common aggregates of secondary lime; violently effervescent; moderately alkaline; gradual wavy boundary.

C3ca-30 to 40 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; finely stratified with silt; few very fine roots; few very fine tubular pores; common aggregates of secondary lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

C4ca-40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine tubular pores; strongly effervescent; moderately alkaline.

The A horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is silt loam, fine sandy loam, or loamy fine sand and is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 when dry and 4 to 6 when moist, and chroma of 2 or 3 when dry or moist. It is silt loam or very fine sandy loam and is moderately alkaline or strongly alkaline.

Kiona series

The Kiona series consists of very deep, well drained soils on hillsides. These soils formed in colluvium derived from loess and basalt. Slope is 25 to 65 percent. Elevation is 600 to 2,500 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 210 days.

These soils are loamy-skeletal, mixed, mesic Xerollic Camborthids.

Typical pedon of Kiona cobbly very fine sandy loam, 25 to 65 percent slopes, about 5 miles southeast of Royal City, 2,440 feet south and 1,540 feet east of the northwest corner of sec. 3, T. 15 N., R. 26 E.

A1-0 to 3 inches; brown (10YR 5/3) cobbly very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, nonsticky and slightly plastic; many very fine roots; 10 percent pebbles and 15 percent cobbles; mildly alkaline; clear smooth boundary.

B2-3 to 19 inches; brown (10YR 5/3) cobbly very fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, friable, nonsticky and slightly plastic; few very fine roots; few very fine tubular pores; 15 percent pebbles and 20 percent angular basaltic cobbles; mildly alkaline; clear wavy boundary.

C1ca-19 to 60 inches; brown (10YR 5/3) very cobbly sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; 30 percent pebbles, 25 percent cobbles, and 1 percent stones; coatings of secondary lime on pebbles and cobbles; few aggregates of lime; strongly effervescent; moderately alkaline.

Depth to lime is 10 to 30 inches. The control section averages 35 to 75 percent coarse fragments.

The A horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is cobbly very fine sandy loam or stony silt loam.

The B horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is cobbly very fine sandy loam, cobbly silt loam, very cobbly loam, or very cobbly very fine sandy loam.

The C horizon has value of 5 to 7 when dry and 3 to 5 when moist. It has chroma of 2 or 3 when dry or moist, or it is dominated by dark colored basaltic sand. The C horizon is very cobbly sandy loam, extremely cobbly loam, very cobbly silt loam, or extremely cobbly sandy loam. It is mildly alkaline or moderately alkaline.

Kittitas series

The Kittitas series consists of very deep, somewhat poorly drained, salt- and alkali-affected soils on alluvial plains. These soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 500 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 150 days.

These soils are fine-silty, mixed (calcareous), mesic Fluvaquentic Haplaquolls.

Typical pedon of Kittitas silt loam about 1 1/2 miles northwest of Corfu, 2,300 feet south and 600 feet west of the northeast corner of sec. 31, T. 16 N., R. 27 E.

Ap-0 to 10 inches; grayish brown (10YR 5/2) silt loam,,, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A1-10 to 20 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1-20 to 32 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; slightly effervescent; moderately alkaline; clear wavy boundary.

C2-32 to 42 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, slightly sticky

and slightly plastic; few fine roots; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C3-42 to 52 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; massive; soft, friable, sticky and plastic; few fine roots; slightly effervescent; moderately alkaline; gradual wavy boundary.

C4g-52 to 60 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 or 2 when dry or moist. The lower part of the A horizon is silt loam or silty clay loam. The A horizon is moderately alkaline or strongly alkaline.

The C horizon has hue of 10YR or 2.5Y, and it has value of 5 or 6 when dry and 3 or 4 when moist. It is silt loam, very fine sandy loam, or silty clay loam above a depth of 40 inches, and it ranges from silty clay loam to fine sandy loam below this depth. The C horizon is mildly alkaline or moderately alkaline.

Koehler series

The Koehler series consists of moderately deep, somewhat excessively drained soils on terraces. These soils formed in eolian sand. Slope is 0 to 10 percent. Elevation is 600 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 150 to 200 days.

These soils are sandy, mixed, mesic Xerollic Durorthids.

Typical pedon of Koehler loamy fine sand, 0 to 10 percent slopes, about 7 miles southwest of George, 800 feet south and 350 feet west of the northeast corner of sec. 15, T. 17 N., R. 23 E.

A1-0 to 3 inches; very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; single grain; loose, very friable; common very fine roots; 5 percent fine caliche pebbles; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1-3 to 10 inches; very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; single grain; loose, very friable; few very fine roots; 5 percent fine caliche pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2ca-10 to 20 inches; very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; single grain; loose, very friable; few very fine roots; 5 percent fine caliche pebbles; common spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; clear smooth boundary.

C3ca-20 to 27 inches; very pale brown (10YR 7/3) very gravelly fine sand, brown (10YR 5/3) moist; single grain; loose, very friable; few very fine roots; 40 percent caliche pebbles; common spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; clear wavy boundary.

C4ca-27 to 33 inches; very pale brown (10YR 8/3) very gravelly fine sand, pale brown (10YR 6/3) moist; single grain; loose, very friable; few very fine roots; 50 percent caliche pebbles; common spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; clear wavy boundary.

C5casim-33 inches; duripan that is cemented with lime and silica.

Depth to the duripan is 20 to 40 inches. The profile averages 5 to 35 percent lime- and silica-cemented fragments. The A horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. The C and Cca horizons have a value of 6 to 8 when dry and 3 to 6 when moist, and they have chroma of 2 or 3 when dry or moist. The C horizon and the upper part of the Cca horizon are loamy sand or loamy fine sand.

Lickskillet series

The Lickskillet series consists of shallow, well drained soils on hillsides. These soils formed in colluvium derived from loess and basalt. Slope is 5 to 65 percent. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 160 days.

These soils are loamy-skeletal, mixed, mesic Lithic Haploxerolls.

Typical pedon of Lickskillet very cobbly loam, 35 to 65 percent slopes, about 2 miles north of Ephrata, 240 feet east and 420 feet north of the southwest corner of sec. 34, T. 22 N., R. 26 E.

A1-0 to 4 inches; brown (10YR 5/3) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; 20 percent pebbles and 20 percent cobbles; 5 percent stones on surface; neutral; clear wavy boundary.

B1-4 to 11 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; 30 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

B2-11 to 15 inches; yellowish brown (10YR 5/4) very gravelly loam, brown (10YR 4/3) moist; moderate

fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; 40 percent pebbles and 10 percent cobbles; neutral; abrupt wavy boundary.

IIR-15 inches; basalt.

The depth to basalt and thickness of the solum range from 12 to 20 inches. The thickness of the mollic epipedon ranges from 7 to 15 inches. The A horizon has value of 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. The B horizon has value of 5 or 6 when dry, and it has chroma of 3 or 4 when dry or moist. It is very gravelly loam, extremely gravelly clay loam, or very cobbly loam.

Magallon series

The Magallon series consists of very deep, somewhat excessively drained soils on terraces. These soils formed in sandy glacial outwash. Slope is 0 to 10 percent. Elevation is 1,300 to 1,700 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 165 days.

These soils are sandy, mixed, mesic Aridic Haploxerolls.

Typical pedon of Magallon sandy loam, 0 to 5 percent slopes (fig. 9), about 2 1/2 miles north of Soap Lake, 2,390 feet west and 1,800 feet south of the northeast corner of sec. 6, T. 22 N., R. 27 E.

Ap-0 to 8 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine roots; few fine tubular pores; neutral; abrupt smooth boundary.

B2-8 to 23 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; few fine tubular pores; mildly alkaline; abrupt wavy boundary.

C1-23 to 32 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) moist; single grain; loose; common very fine roots; few fine tubular pores; moderately alkaline; abrupt wavy boundary.

C2-32 to 60 inches; dark gray (10YR 4/1) coarse sand, black (10YR 2/1) moist; single grain; loose; 10 percent fine pebbles; moderately alkaline.

Depth to coarse sand is 20 to 40 inches. Thickness of the solum is 15 to 25 inches.

The A horizon has value of 4 or 5 when dry. It is neutral or mildly alkaline.

The B horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when dry or moist. It is sandy loam, fine sandy loam, or very fine sandy loam and is mildly alkaline or moderately alkaline.

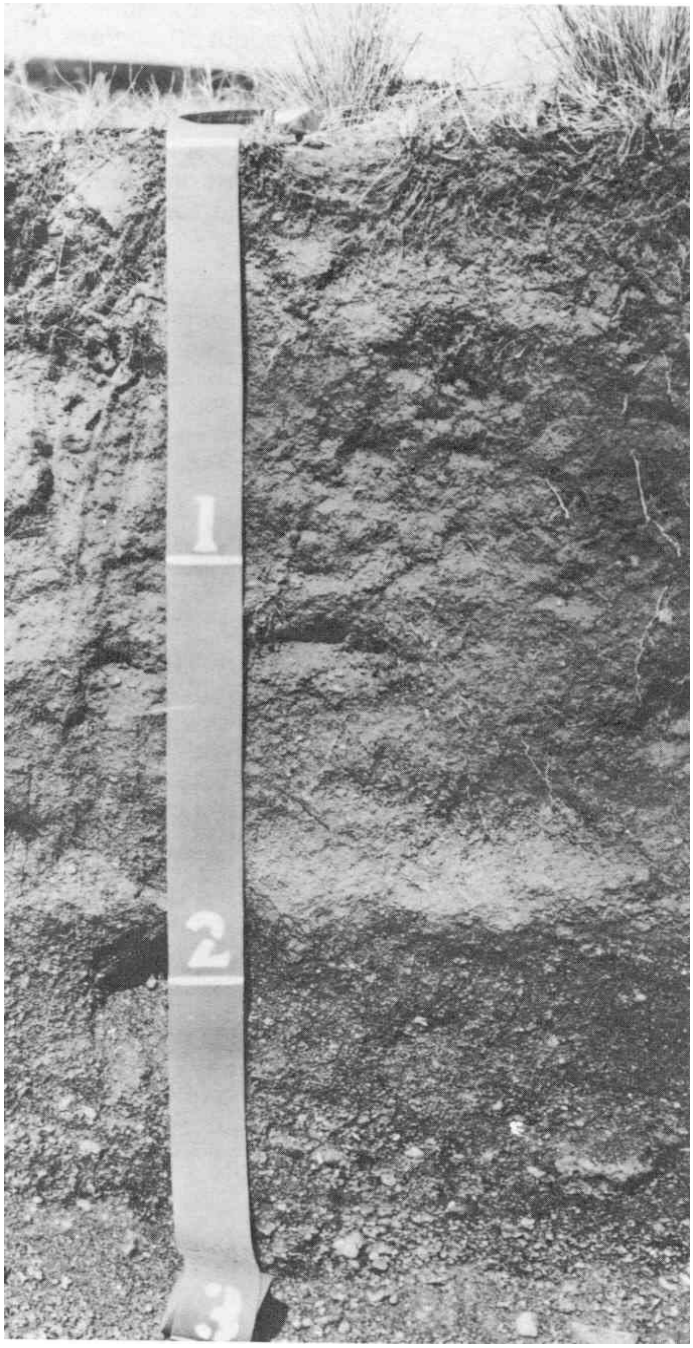

Figure 9.-Profile of Magallon sandy loam, 0 to 5 percent slopes.

The C horizon is loamy sand to sand and is mildly alkaline or moderately alkaline.

Malaga series

The Malaga series consists of very deep, somewhat excessively drained soils on terraces and terrace escarpments. These soils formed in glacial outwash. Slope is 0 to 35 percent. Elevation is 450 to 1,300 feet.

The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 195 days.

These soils are sandy-skeletal, mixed, mesic Xerollic Camborthids.

Typical pedon of Malaga gravelly sandy loam, 0 to 5 percent slopes, about 4 miles northwest of Moses Lake, 180 feet north and 980 feet west of the southeast corner of sec. 26, T. 20 N., R. 27 E.

Ap-0 to 6 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; 20 percent pebbles; mildly alkaline; abrupt smooth boundary.

B21-6 to 11 inches; pale brown (10YR 6/3) gravelly sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; common fine tubular pores; 20 percent pebbles and 10 percent cobbles; mildly alkaline; clear wavy boundary.

B22-11 to 18 inches; pale brown (10YR 6/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; 45 percent pebbles and 15 percent cobbles; mildly alkaline; clear wavy boundary.

IIC1ca-18 to 22 inches; dark gray (10YR 4/1) extremely gravelly loamy sand, very dark gray (10YR 3/1) moist; single grain; loose; few fine roots; 55 percent pebbles and 20 percent cobbles; coatings of secondary lime on pebbles and cobbles; slightly effervescent; moderately alkaline; clear irregular boundary.

IIC2-22 to 60 inches; gray (10YR 5/1) extremely gravelly coarse sand, very dark gray (10YR 3/1) moist; single grain; loose; few fine roots; 55 percent pebbles and 15 percent cobbles; coatings of lime and silica on underside of pebbles and cobbles; strongly effervescent; moderately alkaline.

Thickness of the solum and depth to the IIC horizon range from 15 to 24 inches. The control section averages 50 to 85 percent rock fragments.

The A horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is gravelly sandy loam, cobbly sandy loam, stony sandy loam, very cobbly sandy loam, or very stony sandy loam.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. The upper part of the horizon is gravelly sandy loam, gravelly fine sandy loam, or very gravelly sandy loam, and the lower part is very gravelly sandy loam, very gravelly fine sandy loam, or extremely gravelly sandy loam.

The IIC horizon is multicolored extremely gravelly coarse sand, very gravelly coarse sand, or very cobbly sand.

Neppel series

The Neppel series consists of very deep, well drained soils on terraces. These soils formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 10 percent. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 180 days.

These soils are coarse-loamy over sandy or sandy-skeletal, mixed, mesic Durixerollic Camborthids.

Typical pedon of Neppel very fine sandy loam, 2 to 5 percent slopes, about 1/3 mile north of Warden, 2,060 feet north and 2,550 feet west of the southeast corner of sec. 9, T. 17 N., R. 30 E.

A1-0 to 7 inches; pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; mildly alkaline; abrupt smooth boundary.

B2-7 to 16 inches; pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; mildly alkaline; abrupt wavy boundary.

C1ca-16 to 27 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; 5 percent pebbles; common aggregates of secondary lime; violently effervescent; moderately alkaline; clear smooth boundary.

IIC2casi-27 to 31 inches; light brownish gray (2.5Y 6/2) gravelly fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, nonsticky and nonplastic; few very fine roots; discontinuous lenses that are weakly cemented with lime and silica and are 1 /8 inch thick; 25 percent durinodes that are cemented with lime and silica; 5 percent pebbles; violently effervescent; strongly alkaline; abrupt smooth boundary.

IIIC3-31 to 60 inches; light gray (2.5Y 7/2) extremely gravelly sand, grayish brown (2.5Y 5/2) moist; single grain; loose; few very fine roots; 55 percent pebbles, 15 percent cobbles, and 1 percent stones; violently effervescent; strongly alkaline.

Depth to the IIIC horizon ranges from 20 to 40 inches. The profile is neutral to strongly alkaline. The upper part of the control section is 2 to 10 percent pebbles and 0 to 2 percent cobbles and stones, and the lower part is

35 to 85 percent rock fragments. About 20 to 30 percent of the rock fragments are cemented with lime and silica.

The A horizon has value of 5 or 6 when dry. It is very fine sandy loam or fine sandy loam.

The B horizon has value of 5 or 6 when dry. It is loam, very fine sandy loam, or fine sandy loam.

The C horizon has value of 5 or 6 when dry, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or fine sandy loam.

The IIC horizon has hue of 10YR or 2.5Y. It is gravelly fine sandy loam or gravelly very fine sandy loam.

The IIIC horizon has hue of 10YR or 2.5Y, and it has value of 6 to 8 when dry and 4 or 5 when moist. It is extremely gravelly sand or extremely gravelly coarse sand.

Novark series

The Novark series consists of very deep, well drained soils on terraces. These soils formed in a mantle of loess overlying sandy glacial outwash and alluvium. Slope is 2 to 5 percent. Elevation is 900 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 150 to 170 days.

These soils are coarse-silty over sandy or sandy-skeletal, mixed, mesic Xerollic Camborthids.

Typical pedon of Novark silt loam, 2 to 5 percent slopes, about 3 1/2 miles north of Warden, 1,660 feet east and 2,430 feet south of the northwest corner of sec. 28, T. 18 N., R. 30 E.

Ap-0 to 5 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few medium roots and common very fine and fine roots; many very fine discontinuous pores; mildly alkaline; gradual wavy boundary.

B21-5 to 12 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak fine prismatic structure; soft, very friable, slightly sticky and slightly plastic; few medium roots and common very fine and fine roots; common very fine discontinuous pores; mildly alkaline; gradual smooth boundary.

C1ca-12 to 26 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; impure masses of secondary lime and few aggregates of lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2ca-26 to 30 inches; white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; very hard, very firm, sticky and plastic; few very fine roots; common very fine tubular pores; friable impure masses of secondary lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

IIC3-30 to 60 inches; very dark gray (10YR 3/1) and white (10YR 8/1) fine sand, black (10YR 2/1) and light gray (10YR 7/1) moist; single grain; loose; moderately alkaline.

Depth to the IIC horizon is 20 to 40 inches.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is silt loam or very fine sandy loam.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 when dry or moist, and chroma of 1 to 3 when dry or moist. It is very fine sandy loam or silt loam.

The IIC horizon dominantly is dark colored basaltic sand. It is fine sand, sand, or coarse sand.

Outlook series

The Outlook series consists of very deep, somewhat poorly drained, salt- and alkali-affected soils on alluvial plains. These soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 600 to 2,000 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 150 days.

These soils are coarse-silty, mixed (calcareous), mesic Aeric Halaquepts.

Typical pedon of Outlook very fine sandy loam about 4 miles east of Moses Lake, 100 feet west and 200 feet south of the northeast corner of sec. 28, T. 19 N., R. 29 E.

Ap-0 to 6 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; few very fine tubular pores; slightly effervescent; strongly alkaline; abrupt smooth boundary.

A1g-6 to 10 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; common medium distinct mottles that are dark yellowish brown (10YR 4/4) when moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; few very fine tubular pores; slightly effervescent; strongly alkaline; clear wavy boundary.

C1g-10 to 23 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; common medium distinct mottles that are dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; strongly alkaline; gradual wavy boundary.

C2g-23 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; common medium distinct

mottles that are dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, slightly sticky and slightly plastic; slightly effervescent; strongly alkaline.

The water table fluctuates between depths of 6 and 40 inches. Sodium saturation is 15 percent or more in the upper 10 to 20 inches of the profile, but it decreases with depth. The profile has hue of 2.5Y or 10YR.

The Ap horizon has value of 2 or 3 when moist and 4 or 5 when dry. The Ag horizon has value of 3 or 4 when moist and 5 or 6 when dry. The mottles have value of 4 or 5 when moist. The Cg horizon has value of 3 to 5 when moist and 5 to 7 when dry, and it has chroma of 3 or 4 when moist or dry. The mottles have value of 4 or 5 when moist. The Cg horizon is silt loam or very fine sandy loam and is moderately alkaline or strongly alkaline.

Pedigo series

The Pedigo series consists of very deep, somewhat poorly drained, salt- and sodium-affected soils on alluvial plains. These soils formed in alluvium derived from loess and some volcanic ash. Slope is 0 to 2 percent. Elevation is 1,300 to 2,400 feet. The average annual precipitation is about 11 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 110 to 130 days.

These soils are coarse-silty, mixed, mesic Cumulic Haploxerolls.

Typical pedon of Pedigo silt loam about 6 miles south of Electric City, 680 feet east and 2,400 feet north of the southwest corner of sec. 21, T. 27 N., R. 30 E.

Ap-0 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, firm, slightly sticky and slightly plastic; many very fine roots and few fine roots; many very fine tubular pores; common dark stains on faces of pads; slightly effervescent; very strongly alkaline; abrupt smooth boundary.

A12-11 to 25 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.

A13-25 to 35 inches; dark grayish brown (10YR 4/2) silt loam, black (10YR 2/1) moist; massive; hard, firm, sticky and plastic; very few very fine roots; many very fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.

C-35 to 60 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; slightly effervescent; strongly alkaline.

The A horizon has chroma of 1 to 3 when dry or moist. It is 20 to 40 inches thick or more and is strongly alkaline or very strongly alkaline.

Prosser series

The Prosser series consists of moderately deep, well drained soils on benches and hillsides. These soils formed in loess. Slope is 0 to 45 percent. Elevation is 600 to 2,600 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 210 days.

These soils are coarse-loamy, mixed, mesic Xerollic Camborthids.

Typical pedon of Prosser very fine sandy loam, 2 to 5 percent slopes, about 2 1 /2 miles northwest of Royal City, 200 feet south and 1,440 feet west of the northeast corner of sec. 22, T. 17 N., R. 25 E.

A1-0 to 5 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

B2-5 to 16 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; mildly alkaline; clear wavy boundary.

C1ca-16 to 26 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; common spheroidal aggregates of secondary lime; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIR-26 inches; basalt; lime in cracks and on surface.

Depth to basalt is 20 to 40 inches. The A horizon has value of 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline. The B horizon has value of 5 or 6 when dry. It is very fine sandy loam or silt loam. The C horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or silt loam.

Quincy series

The Quincy series consists of very deep, somewhat excessively drained soils on terraces and active dunes. These soils formed in sand derived from mixed sources. Slope is 0 to 35 percent. Elevation is 300 to 2,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 135 to 200 days.

These soils are mixed, mesic Xeric Torripsamments.

Typical pedon of Quincy fine sand, 2 to 15 percent slopes, about 3 1/2 miles southeast of George, 100 feet west and 1,800 feet north of the southeast corner of sec. 14, T. 18 N., R. 24 E.

C1-0 to 9 inches; brown (10YR 5/3) fine sand, very dark grayish brown (10YR 3/2) moist; single grain; loose; many very fine and fine roots; neutral; clear wavy boundary.
C2-9 to 60 inches; brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grain; loose; common very fine and fine roots; mildly alkaline.

The C horizon has value of 4 to 6 when dry and 3 to 5 when moist, and it has chroma of 2 or 3 when moist or dry. The C1 horizon is sand, fine sand, or loamy fine sand.

Quinton series

The Quinton series consists of moderately deep, somewhat excessively drained soils on hillsides and benches. They formed in eolian sand. Elevation is 1,000 to 2,300 feet. Slope is 5 to 20 percent. The average annual precipitation is about 7 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 140 to 180 days.

These soils are mixed, mesic Xeric Torripsamments.

Typical pedon of a Quinton loamy fine sand in an area of Quinton-Schawana complex, 5 to 20 percent slopes, about 2 miles southeast of Schawana, 1,420 feet south and 2,200 feet west of the northeast corner of sec. 12, T. 15 N., R. 23 E.

C1-0 to 7 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; many very fine roots; less than 5 percent pebbles; mildly alkaline; gradual wavy boundary.
C2-7 to 14 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; many very fine and fine roots; 5 percent pebbles; mildly alkaline; gradual *wavy* boundary.
C3-14 to 22 inches; brown (10YR 5/3) gravelly loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; common very fine and fine roots; strongly effervescent; 30 percent pebbles; moderately alkaline; abrupt wavy boundary.
IIR-22 inches; fractured basalt that is coated with lime.

Depth to basalt ranges from 20 to 40 inches. The control section is loamy fine sand, gravelly loamy fine sand, or sand.

The C horizon has value of 4 to 6 when dry.

Rails series

The Rails series consists of very deep, well drained soils on hillsides. These soils formed in colluvium derived from basalt and in loess. Slope is 3 to 45 percent. Elevation is 1,400 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 160 days.

These soils are fine-loamy, mixed, mesic Aridic Argixerolls.

Typical pedon of a Rails silt loam in an area of Zen-Lickskillet-Ralls complex, 5 to 45 percent slopes, about 2 miles north of Ephrata, 140 feet south and 460 feet west of the northeast corner of sec. 4, T. 21 N., T. 26 E.

A11-0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine vesicular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.
A12-8 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine vesicular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.
B21-13 to 19 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; thin patchy clay films on faces of peds and in pores; many very fine roots; common very fine vesicular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.
B22t-1 9 to 44 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure; hard, firm, slightly sticky and slightly plastic; thin patchy clay films on faces of peds and in pores; common very fine roots; common very fine vesicular pores; 10 percent pebbles; mildly alkaline; clear smooth boundary.
C1ca-44 to 48 inches; brown (10YR 5/3) very gravelly silt loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 35 percent pebbles and 10 percent cobbles; secondary lime in pores; strongly effervescent; strongly alkaline; abrupt smooth boundary.
C2ca-48 to 60 inches; pale brown (10YR 6/3) gravelly clay loam, brown (10YR 4/3) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; many very fine tubular pores; 30 percent pebbles and 5 percent cobbles; violently

effervescent; lime in pores and on faces of peds; strongly alkaline.

The solum is 20 to 44 inches thick. The control section is 15 to 35 percent rock fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is stony in some pedons.

The B horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. It is silt loam, gravelly silt loam, or gravelly clay loam.

The C horizon has value of 5 or 6 when dry, and it has chroma of 3 or 4 when dry or moist. It is gravelly silt loam, very gravelly silt loam, or gravelly clay loam and is moderately alkaline or strongly alkaline.

Renslow series

The Renslow series consists of very deep, well drained soils on hills. These soils formed in loess. Slope is 0 to 35 percent. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 11 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

These soils are coarse-silty, mixed, mesic Aridic Calcic Argixerolls.

Typical pedon of Renslow silt loam, 0 to 5 percent slopes, about 5 1/2 miles northeast of Ephrata, 2,300 feet east of the southwest corner of sec. 27, T. 22 N., R. 25 E.

Ap-0 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; mildly alkaline; abrupt smooth boundary.

B1-11 to 24 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few thin clay films on faces of peds; mildly alkaline; clear wavy boundary.

B21t-24 to 32 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable, sticky and plastic; many very fine roots; thin continuous clay films on faces of peds and in pores; moderately alkaline; gradual wavy boundary.

B22t-32 to 40 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few thin clay films on faces of peds; moderately alkaline; clear wavy boundary.

Cca-40 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots; carbonate material in pores and seams; strongly alkaline.

Thickness of the solum and depth to secondary lime are 20 to 43 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline.

The B horizon has value of 4 to 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. It is mildly alkaline or moderately alkaline.

The C horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. It is moderately alkaline or strongly alkaline.

Ritzville series

The Ritzville series consists of very deep, well drained soils on hills. These soils formed in loess. Slope is 0 to 25 percent. Elevation is 1,400 to 1,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 140 to 160 days.

These soils are coarse-silty, mixed, mesic Calciorthidic Haploxerolls.

Typical pedon of a Ritzville silt loam in an area of Ritzville association, about 3 1/2 miles north of Trinidad, 156 feet west and 1,400 feet south of the northeast corner of sec. 30, T. 21 N., R. 23 E.

Ap-0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few fine tubular pores; mildly alkaline; abrupt smooth boundary.

B21-6 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; mildly alkaline; clear wavy boundary.

B22-21 to 39 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; mildly alkaline; gradual wavy boundary.

C1ca-39 to 51 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; few aggregates of secondary lime and lime in pores; strongly effervescent; strongly alkaline; gradual wavy boundary.

C2ca-51 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; friable impure masses of secondary lime; strongly effervescent; strongly alkaline.

Thickness of the solum and depth to lime are 30 to 43 inches.

The A horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline.

The B horizon has value of 4 or 5 when dry and 3 or 4 when moist. It is neutral or mildly alkaline.

The C horizon has value of 5 to 7 when dry and 4 or 5 when moist. It is moderately alkaline or strongly alkaline.

Roloff series

The Roloff series consists of moderately deep, well drained soils on benches and hillsides. These soils formed in loess. Slope is 0 to 25 percent. Elevation is 1,300 to 2,200 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 135 to 160 days.

These soils are coarse-loamy, mixed, mesic Aridic Haploxerolls.

Typical pedon of a Roloff silt loam in an area of Roloff-Bakeoven complex, 5 to 25 percent slopes, about 5 miles northwest of Hartline, 150 feet west and 30 feet south of the northeast corner of sec. 30, T. 26 N., R. 29 E.

A11-0 to 5 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine vesicular pores; neutral; abrupt smooth boundary.

A12-5 to 11 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; many fine tubular pores; neutral; clear smooth boundary.

B2-11 to 17 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine tubular pores; mildly alkaline; abrupt wavy boundary.

C1-17 to 29 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; moderately alkaline; abrupt irregular boundary.

IIR-29 inches; basalt.

Depth to basalt is 20 to 40 inches. Thickness of the solum is 15 to 25 inches. The control section is 5 to 25 percent coarse fragments.

The A horizon has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline.

The B horizon has value of 5 or 6 when dry, and it has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline.

The C horizon has value of 5 or 6 when dry, and it has chroma of 2 to 4 when dry or moist. It is silt loam or gravelly silt loam and is mildly alkaline to strongly alkaline.

Royal series

The Royal series consists of very deep and deep, well drained soils on foot slopes and terraces. These soils formed in sandy alluvium. Slope is 0 to 25 percent. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 140 to 200 days.

These soils are coarse-loamy, mixed, mesic Xerollic Camborthids.

Typical pedon of Royal very fine sandy loam, 2 to 5 percent slopes, about 2 miles northeast of Warden, 1,100 feet west and 1,500 feet north of the southeast corner of sec. 12, T. 17 N., R. 30 E.

Ap-0 to 10 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; mildly, alkaline; abrupt smooth boundary.

B2-10 to 16 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; mildly alkaline; abrupt smooth boundary.

C1ca-16 to 31 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine pores; many spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; clear smooth boundary.

C2ca-31 to 55 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; few very fine roots; few very fine pores; common spheroidal aggregates of secondary lime; violently effervescent; moderately alkaline; clear smooth boundary.

C3ca-55 to 60 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common spheroidal aggregates

of secondary lime; strongly effervescent; moderately alkaline.

Thickness of the solum is 13 to 26 inches. Depth to secondary lime is 13 to 44 inches. The 10- to 40-inch control section averages fine sandy loam or very fine sandy loam. The solum is neutral or mildly alkaline. Some pedons have a hardpan at a depth of 40 to 60 inches.

The A horizon has value of 5 or 6 when dry and 3 to 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is loamy fine sand or very fine sandy loam.

The B horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or fine sandy loam.

The C horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 1 to 3 when moist. It is stratified fine sandy loam, very fine sandy loam, loamy fine sand, and fine sand and is moderately alkaline or strongly alkaline.

Sagehill series

The Sagehill series consists of very deep, well drained soils on terraces. These soils formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. Elevation is 600 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 170 days.

These soils are coarse-loamy, mixed, mesic Xerollic Camborthids.

Typical pedon of Sagehill very fine sandy loam, 0 to 2 percent slopes, about 2 miles north of Warden, 2,440 feet north and 2,170 feet east of the southwest corner of sec. 32, T. 18 N., R. 30 E.

Ap-0 to 8 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; very weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; mildly alkaline; abrupt smooth boundary.

B2-8 to 19 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak very coarse prismatic structure; soft, very friable, nonsticky and nonplastic; common very fine roots; mildly alkaline; abrupt wavy boundary.

IIC1ca-19 to 30 inches; pale brown (10YR 6/3) very fine sandy loam, grayish brown (2.5Y 5/2) moist; weak very coarse prismatic structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; few spheroidal aggregates of secondary lime; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2ca-30 to 39 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; secondary lime in seams; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIC3ca-39 to 52 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; common aggregates of secondary lime; violently effervescent; strongly alkaline; abrupt smooth boundary.

IIC4ca-52 to 60 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; few spheroidal aggregates of secondary lime; strongly effervescent; strongly alkaline.

The thickness of the solum and depth to lime range from 15 to 30 inches. The solum is less than 10 percent clay.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when moist. It is neutral or mildly alkaline.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam, loamy very fine sand, or fine sandy loam and is neutral to moderately alkaline.

The IIC horizon has value of 6 or 7 when dry and 4 or 5 when moist. It is stratified silt loam, very fine sandy loam, and fine sandy loam.

Sagemoor series

The Sagemoor series consists of very deep, well drained soils on terraces. These soils formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 170 days.

These soils are coarse-silty, mixed, mesic Xerollic Camborthids.

Typical pedon of Sagemoor silt loam, 2 to 5 percent slopes (fig. 10), about 7 miles northeast of Warden, 2,440 feet north and 700 feet east of the southwest corner of sec. 7, T. 18 N., R. 30 E.

Ap-0 to 9 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; mildly alkaline; abrupt smooth boundary.

B2-9 to 19 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak medium and coarse prismatic structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; mildly alkaline; abrupt wavy boundary.

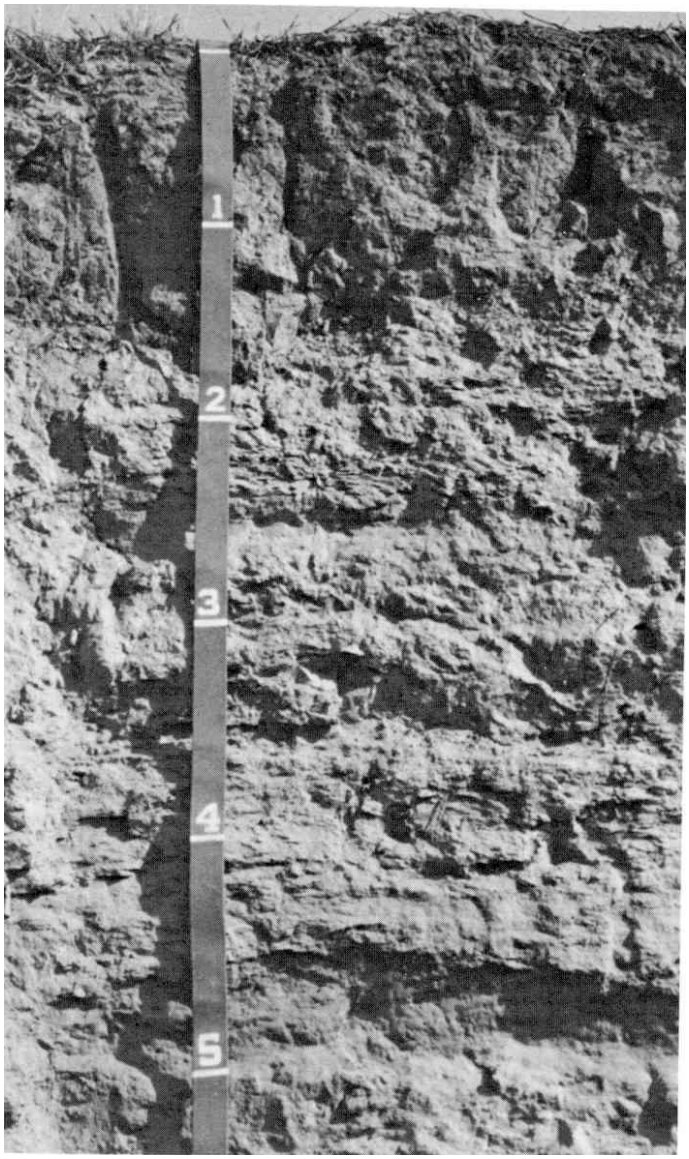

Figure 10.-Profile of Sagemoor silt loam, 2 to 5 percent slopes.

IIC1ca-19 to 25 inches; light brownish gray (2.5Y 6/2) stratified silt loam and very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; silt loam is hard, firm, slightly sticky and slightly plastic; very fine sandy loam is slightly hard, friable, nonsticky and nonplastic; very finely stratified with silt; few fine roots; many very fine tubular pores; lime in seams on the surface of plates; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIC2-25 to 34 inches; light brownish gray (2.5Y 6/2) stratified silt loam and very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; silt loam is hard, firm, slightly sticky and slightly plastic; very fine sandy loam is slightly hard, friable, nonsticky and nonplastic; very finely stratified with silt; few fine roots; many very fine tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

IIC3-34 to 40 inches; grayish brown (2.5Y 5/2) stratified silt loam and very fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; massive; silt loam is hard, firm, slightly sticky and slightly plastic; very fine sandy loam is slightly hard, friable, nonsticky and nonplastic; very finely stratified with silt; few fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline; clear *wavy* boundary.

IIC4-40 to 46 inches; grayish brown (2.5Y 5/2) very fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IIC5-46 to 60 inches; grayish brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; massive; hard, firm, slightly sticky and slightly plastic; very finely stratified with silt; few very fine tubular pores; strongly effervescent; strongly alkaline.

Thickness of the solum and depth to lime range from 14 to 24 inches.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is neutral or mildly alkaline.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist.

The IIC horizon has hue of 10YR or 2.5Y, and it has value of 5 to 7 when dry and 3 or 4 when moist. It dominantly is silt loam and very fine sandy loam but has very thin strata of silt and very fine sand.

Saltese series

The Saltese series consists of very deep, artificially drained soils in basins. These soils formed in decomposed litter of reeds, sedges, and other plant material and in alluvium. Slope is 0 to 2 percent. Elevation is 1,050 to 1,300 feet. The average annual precipitation is about 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 120 to 130 days.

These soils are euic, mesic Typic Medisaprists.

Typical pedon of Saltese muck about 1. mile east of Wilson Creek, 2,330 feet east and 1,400 feet north of the southwest corner of sec. 8, T. 22 N., R. 30 E.

Oap-0 to 9 inches; black (10YR 2/1, rubbed) sapric material, gray (10YR 5/1) dry; about 20 percent fibers, less than 5 percent rubbed; moderate coarse granular structure and moderate coarse subangular blocky; hard, very friable, nonsticky and nonplastic;

many very fine roots; moderately alkaline; abrupt smooth boundary.

Oa1-9 to 13 inches; black (10YR 2/1, rubbed) sapric material, gray (10YR 5/1) dry; about 45 percent fibers, less than 5 percent rubbed; moderate coarse subangular blocky structure; hard, very friable, nonsticky and nonplastic; many very fine roots; dark grayish brown (10YR 4/2) discontinuous lenses of diatomaceous earth and volcanic ash 1/4 to 1/2 inch thick; mildly alkaline; abrupt wavy boundary.

Oa2-13 to 17 inches; black (N 2/0, rubbed) sapric material, dark grayish brown (10YR 4/2) dry; about 70 percent fibers, less than 5 percent rubbed; moderate medium prismatic structure; hard, very friable, nonsticky and nonplastic; common very fine roots; neutral; abrupt wavy boundary.

C-17 to 18 inches; dark grayish brown (10YR 4/2) diatomaceous earth and volcanic ash, white (10YR 8/1) dry; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; mildly alkaline; abrupt wavy boundary.

O'a1-18 to 32 inches; black (N 2/0, rubbed) sapric material, very dark gray (N 3/0) dry; about 70 percent fibers, about 10 percent rubbed; massive; hard, very friable, nonsticky and nonplastic; common very fine roots; neutral; clear wavy boundary.

O'a2-32 to 41 inches; black (N 2/0, rubbed) sapric material, dark grayish brown (10YR 4/2) dry; about 65 percent fibers, about 5 percent rubbed; massive; hard, very friable, nonsticky and nonplastic; few very fine roots; neutral; clear wavy boundary.

O'a3-41 to 60 inches; black (10YR 2/1, rubbed) sapric material, dark grayish brown (10YR 4/2) dry; about 70 percent fibers, about 8 percent rubbed; massive; hard, very friable, nonsticky and nonplastic; very few very fine roots; neutral.

Thickness of the organic material ranges from 51 inches to more than 10 feet. Depth to discontinuous thin layers of limnic material ranges from 8 to 51 inches or more. The profile is neutral to moderately alkaline in the upper part, and it is neutral or mildly alkaline in the lower part.

The 0 horizon has value of 2 or 3 when moist, and it has chroma of neutral or 1 when moist or dry.

The C horizon has value of 6 to 8 when dry and 4 or 5 when moist, and it has chroma of 1 or 2 when moist. It is less than 2 inches thick.

Schawana series

The Schawana series consists of shallow, somewhat excessively drained soils on hillsides and benches. These soils formed in eolian deposits and in material derived from basalt. Slope is 0 to 55 percent. Elevation is 500 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 140 to 200 days.

These soils are loamy, mixed, nonacid, mesic Lithic Xeric Torriorthents.

Typical pedon of Schawana cobbly loamy fine sand, 15 to 55 percent slopes, about 2 miles southeast of Schawana, 2,100 feet south and 2,400 feet east of the northwest corner of sec. 13, T. 15 N., R. 23 E.

C1-0 to 3 inches; brown (10YR 5/3) cobbly loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; many very fine roots; 20 percent pebbles and 15 percent cobbles; mildly alkaline; clear wavy boundary.

C2-3 to 12 inches; brown (10YR 4/3) gravelly very fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and coarse roots; 25 percent pebbles; mildly alkaline; abrupt wavy boundary.

R-12 inches; basalt.

The depth to basalt ranges from 8 to 20 inches. The control section is 10 to 35 percent rock fragments.

The C1 horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is cobbly loamy fine sand or loamy fine sand.

The C2 horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is gravelly very fine sandy loam, loamy very fine sand, gravelly fine sandy loam, or very fine sandy loam.

Scoon series

The Scoon series consists of very shallow and shallow, well drained soils on terraces and alluvial fans. These soils formed in loess. Slope is 0 to 15 percent. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 210 days.

These soils are loamy, mixed, mesic, shallow Xerollic Durorthids.

Typical pedon of Scoon silt loam, 0 to 5 percent slopes (fig. 11), about 2 miles northwest of George, 890 feet east and 1,500 feet north of the southwest corner of sec. 25, T. 19 N., R. 23 E.

Ap-0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; mildly alkaline; abrupt smooth boundary.

B2-6 to 10 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots;

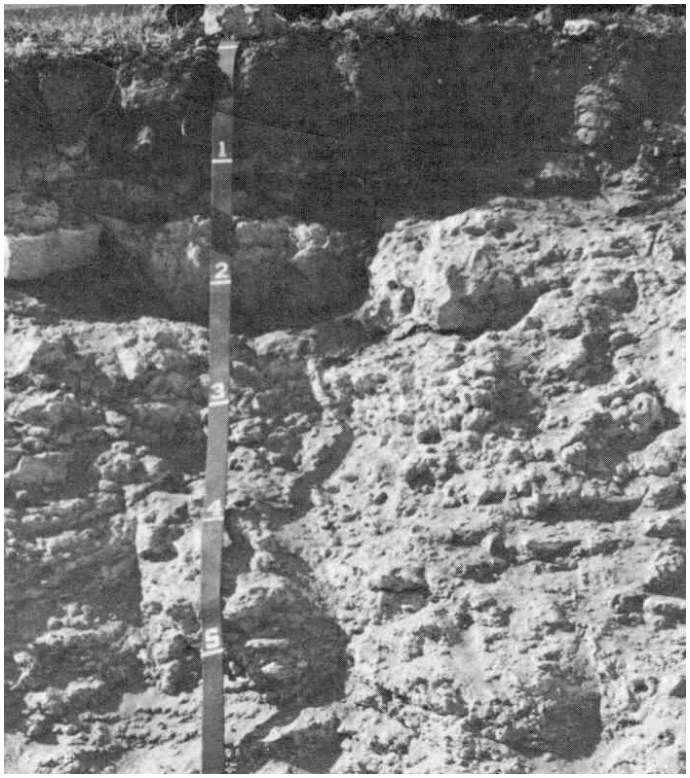

Figure 11.-Profile of Scoon silt loam, 0 to 5 percent slopes.

few fine tubular pores; moderately alkaline; gradual wavy boundary.

C1ca-10 to 16 inches; light brownish gray (10YR 6/2) gravelly silt loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; 30 percent lime and silica fragments; spheroidal aggregates of secondary lime; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2casim-16 inches; indurated duripan that is cemented with lime and silica.

Depth to the duripan is 6 to 20 inches. The duripan is 6 inches to many feet thick. The control section is less than 35 percent rock fragments. The solum is mildly alkaline or moderately alkaline.

The A horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or silt loam. The A horizon is stony in some pedons.

The B horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or silt loam.

The C horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam, silt loam, gravelly silt loam, or gravelly very fine sandy loam.

Shano series

The Shano series consists of very deep, well drained soils on hills. These soils formed in loess. Slope is 0 to 35 percent. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 150 to 200 days.

These soils are coarse-silty, mixed, mesic Xerollic Camborthids.

Typical pedon of Shano silt loam, 2 to 5 percent slopes (fig. 12), about 7 miles east of Moses Lake, 150 feet south and 1,000 feet east of the northwest corner of sec. 19, T. 19 N., R. 30 E.

Ap-0 to 8 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; mildly alkaline; abrupt smooth boundary.

B2-8 to 19 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak coarse and medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; mildly alkaline; gradual wavy boundary.

C1-19 to 33 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; moderately alkaline; clear wavy boundary.

C2ca-33 to 42 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; violently effervescent; moderately alkaline; common hard cicada nodules; gradual wavy boundary.

C3-42 to 57 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few hard cicada nodules; strongly effervescent; strongly alkaline; gradual wavy boundary.

C4-57 to 60 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; strongly effervescent; strongly alkaline.

The solum is 12 to 26 inches thick. Depth to lime ranges from 24 to 40 inches.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. The upper 7 inches, when mixed, is less than 1 percent organic matter. The A horizon is neutral or mildly alkaline.

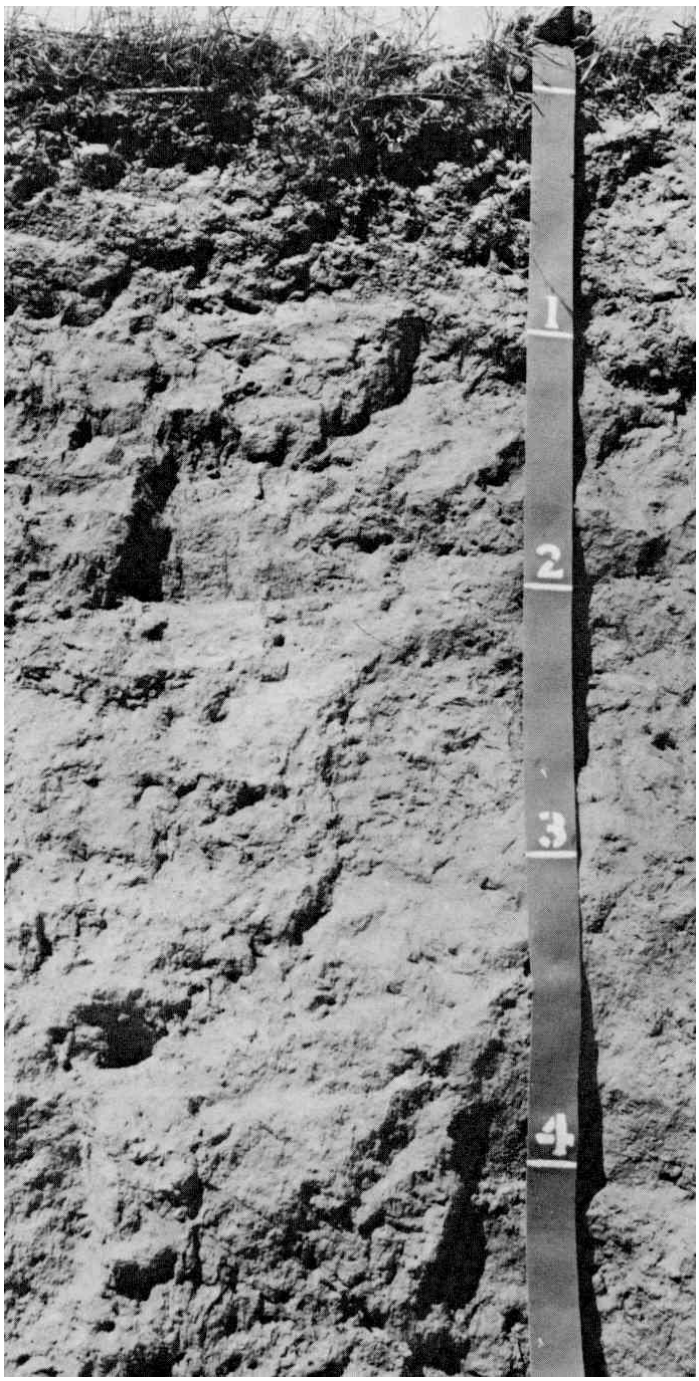

Figure 12.-Profile of Shano silt loam, 2 to 5 percent slopes.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is mildly alkaline or moderately alkaline.

The C horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is moderately alkaline or strongly alkaline.

Starbuck series

The Starbuck series consists of shallow, well drained soils on benches, hillsides, and ridgetops. These soils formed in loess and in material derived from basalt. Slope is 0 to 65 percent. Elevation is 550 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 210 days.

These soils are loamy, mixed, mesic Lithic Xerollic Camborthids.

Typical pedon of Starbuck very fine sandy loam, 0 to 15 percent slopes, about 1/2 mile northeast of Ruff, 1,440 feet west and 1,450 feet north of the southeast corner of sec. 36, T. 20 N., R. 30 E.

A11-0 to 2 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; mildly alkaline; abrupt smooth boundary.

A12-2 to 8 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; mildly alkaline; clear smooth boundary.

B2-8 to 15 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; 5 percent basalt pebbles; mildly alkaline; abrupt wavy boundary.

R-15 inches; basalt.

Depth to bedrock and thickness of the solum are 12 to 20 inches. The control section is 5 to 30 percent coarse fragments and is neutral or mildly alkaline.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. It is very fine sandy loam or silt loam and is stony in some pedons.

The B horizon has value of 5 or 6 when dry, and it has chroma of 3 or 4 when dry or moist. It is very fine sandy loam, silt loam, gravelly silt loam, gravelly very fine sandy loam, or gravelly fine sandy loam.

Strat series

The Strat series consists of very deep, well drained soils on terraces. These soils formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 25 percent. Elevation is 1,100 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 155 days.

These soils are loamy skeletal, mixed, mesic Aridic Haploxerolls.

Typical pedon of Strat stony loam, 0 to 25 percent slopes, about 9 miles northwest of Ephrata, 20 feet south and 250 feet east of the northwest corner of sec. 6, T. 22 N., R. 25 E.

A1-0 to 8 inches; brown (10YR 5/3) stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; 15 percent pebbles and 2 percent stones; neutral clear wavy boundary.

B2-8 to 18 inches; yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 40 percent pebbles and 10 percent cobbles; mildly alkaline; clear wavy boundary.

C1-18 to 23 inches; yellowish brown (10YR 5/4) very cobbly loam, dark brown (10YR 3/3) moist; massive; soft, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 40 percent pebbles and 20 percent cobbles; mildly alkaline; abrupt wavy boundary.

IIC2-23 to 60 inches; gray (10YR 5/1) extremely gravelly coarse sand, very dark gray (10YR 3/1) moist; single grain; loose; 65 percent pebbles and 15 percent cobbles; coatings of silica on undersides of pebbles and cobbles; mildly alkaline.

Depth to the IIC horizon ranges from 16 to 24 inches. The control section is 35 to 75 percent rock fragments and 7 to 15 percent clay. The solum is neutral or mildly alkaline.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. It is gravelly loam, cobbly loam, very cobbly loam, or stony loam.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It is very gravelly loam or very cobbly loam.

The C horizon has value of 5 or 6 when dry, and it has chroma of 3 or 4 when dry or moist. It is very gravelly loam or very cobbly loam.

The IIC horizon has value of 5 to 7 when dry and 3 to 6 when moist, and it has chroma of 1 to 4 when dry or moist. It is sand or coarse sand and is very gravelly, extremely gravelly, or extremely cobbly. The IIC horizon is mildly alkaline or moderately alkaline.

Stratford series

The Stratford series consists of very deep, well drained soils on terraces. These soils formed in glacial outwash that is mixed with loess in the upper part. Slope is 0 to 15 percent. Elevation is 1,100 to 1,600 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 155 days.

These soils are coarse-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Haploxerolls.

Typical pedon of Stratford loam, 0 to 5 percent slopes, about 6 miles northeast of Stratford, 840 feet north and 2,260 feet west of the southeast corner of sec. 4, T. 23 N., R. 28 E.

A1-0 to 7 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine roots; 10 percent pebbles; mildly alkaline; clear wavy boundary.

B2-7 to 20 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; 20 percent pebbles; mildly alkaline; clear wavy boundary.

C1-20 to 30 inches; yellowish brown (10YR 5/4) gravelly loam, dark brown (10YR 3/3) moist; massive; soft, friable, nonsticky and nonplastic; few very fine tubular pores; 30 percent pebbles; moderately alkaline; abrupt wavy boundary.

IIC2-30 to 60 inches; gray (10YR 5/1) extremely gravelly coarse sand, very dark gray (10YR 3/1) moist; single grain; loose; 55 percent pebbles and 10 percent cobbles; coatings of silica on undersides of pebbles; moderately alkaline.

The solum is 12 to 24 inches thick. Depth to the IIC horizon ranges from 20 to 36 inches. The lower part of the control section is 35 to 75 percent coarse fragments.

The A horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when dry or moist. It is gravelly loam or loam and is neutral or mildly alkaline.

The B horizon has value of 3 or 4 when moist. It is gravelly loam or gravelly silt loam and is neutral or mildly alkaline.

The C horizon has value of 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. It is very gravelly loam or gravelly loam.

The IIC horizon is very gravelly coarse sand, extremely gravelly coarse sand, or extremely cobbly coarse sand.

Taunton series

The Taunton series consists of moderately deep, well drained soils on alluvial fans and terraces. These soils formed in loess and alluvium. Slope is 0 to 35 percent. Elevation is 800 to 2,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 210 days.

These soils are coarse-loamy, mixed, mesic Xerollic Durorthids.

Typical pedon of Taunton silt loam, 2 to 5 percent slopes, about 2 miles north of Quincy, 310 feet west and 2,560 feet south of the northeast corner of sec. 31, T. 21 N., R. 24 E.

Ap-0 to 8 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine tubular pores; mildly alkaline; abrupt smooth boundary.

B2-8 to 19 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak medium and coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine and fine tubular pores; mildly alkaline; abrupt wavy boundary.

C1ca-19 to 23 inches; pale brown (10YR 6/3) gravelly silt loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; very few fine tubular pores; 25 percent basalt pebbles; common spheroidal aggregates of secondary lime; strongly effervescent; moderately alkaline; clear wavy boundary.

C2ca-23 to 27 inches; very pale brown (10YR 7/3) gravelly silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common spheroidal aggregates of secondary lime; 20 percent durinodes; 15 percent basalt pebbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

C3casim-27 inches; white (10YR 8/1) indurated duripan consisting of basalt pebbles and cobbles that are cemented with lime and silica, light gray (10YR 7/2) moist; massive; extremely hard, extremely firm; violently effervescent.

Depth to the duripan is 20 to 40 inches. The control section above the pan is 0 to 25 percent rock fragments.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is loamy fine sand, fine sandy loam, or silt loam and is stony in some pedons. It is mildly alkaline or moderately alkaline.

The B horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is silt loam, very fine sandy loam, or loam and is mildly alkaline or moderately alkaline.

The Cca horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 3 or 4 when dry or moist. It is silt loam, gravelly fine sandy loam, very fine sandy loam, gravelly silt loam, or loam and is moderately alkaline or strongly alkaline.

The Ccasim horizon has value of 7 to 9 when dry and 6 or 7 when moist, and it has chroma of 1 to 3 when dry or moist. It is 4 to 40 inches thick over weakly consolidated gravelly alluvial deposits or weakly consolidated lacustrine deposits. The Ccasim horizon is 0 to 50 percent basalt fragments.

Timentwa series

The Timentwa series consists of deep, well drained soils on till plains. These soils formed in glacial till that is mixed with loess in the upper part. Slope is 0 to 15 percent. Elevation is 2,300 to 3,000 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 110 to 140 days.

These soils are coarse-loamy, mixed, mesic Calcic Pachic Haploxerolls.

Typical pedon of Timentwa very fine sandy loam, 0 to 15 percent slopes (fig. 13), about 7 miles north of Coulee City, 1,000 feet south and 2,570 feet east of the northwest corner of sec. 27, T. 26 N., R. 28 E.

A11-0 to 2 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark brown (10YR 2/2) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many fine tubular pores; 5 percent pebbles; mildly alkaline; abrupt smooth boundary.

A12-2 to 9 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many fine tubular pores; 10 percent pebbles; mildly alkaline; clear smooth boundary.

A13-9 to 14 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few fine tubular pores; 10 percent pebbles; mildly alkaline; clear smooth boundary.

B21-14 to 26 inches; brown (10YR 5/3) gravelly very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; 15 percent pebbles; moderately alkaline; clear wavy boundary.

B22-26 to 37 inches; brown (10YR 5/3) gravelly very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few very fine roots; common fine tubular pores; 20 . percent pebbles; moderately alkaline; abrupt wavy boundary.

C1ca-37 to 43 inches; grayish brown (2.5Y 5/2) gravelly fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; 25 percent pebbles and 5 percent cobbles;

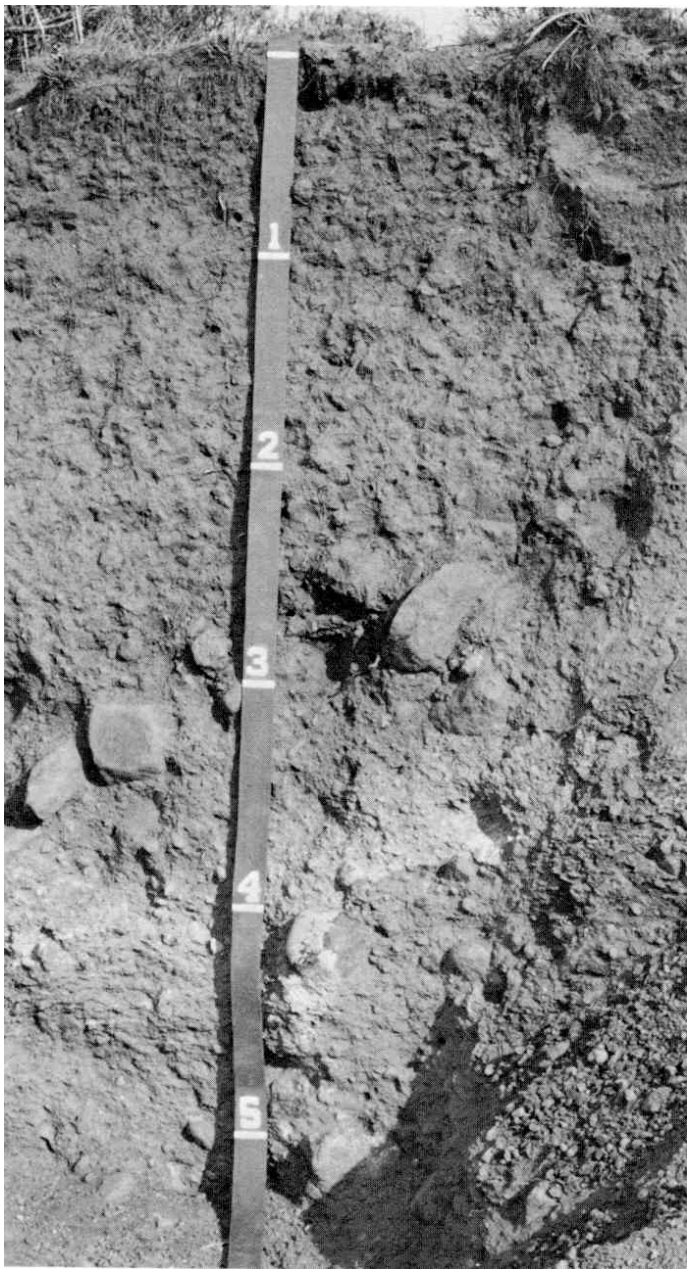

Figure 13.-Profile of Timentwa very fine sandy loam, 0 to 15 percent slopes.

lime in pores; strongly effervescent; strongly alkaline; abrupt wavy boundary.

C2casim-43 to 47 inches; gray (10YR 5/1) discontinuous lenses that are weakly cemented with lime and silica, are 1/8 inch thick, and crush to very gravelly fine sandy loam, dark gray (10YR 4/1) moist; massive; very hard, very firm, nonsticky and nonplastic; few fine tubular pores; 35 percent pebbles, 10 percent cobbles, and 1 percent stones; strongly effervescent; strongly alkaline; clear smooth boundary.

C3ca-47 to 60 inches; gray (10YR 5/1) very gravelly fine sandy loam, dark gray (10YR 4/1) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine tubular pores; 35 percent pebbles, 10 percent cobbles, and 1 percent stones; strongly effervescent; strongly alkaline.

The control section is 15 to 35 percent basalt fragments. Depth to lime ranges from 22 to 43 inches. Depth to the Ccasim horizon ranges from 40 to 55 inches.

The A horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when dry or moist.

The B horizon has value of 4 or 5 when dry. It is very fine sandy loam, fine sandy loam, loam, gravelly very fine sandy loam, or gravelly loam.

The C horizon has value of 5 or 6 when dry and 4 or 5 when moist. It is gravelly fine sandy loam, very gravelly fine sandy loam, cobbly sandy loam, gravelly loam, or very gravelly loam. The C horizon is moderately alkaline or strongly alkaline.

The C2casim horizon crushes to very gravelly fine sandy loam, gravelly fine sandy loam, cobbly sandy loam, gravelly loam, or very gravelly loam. It is moderately alkaline or strongly alkaline.

Timmerman series

The Timmerman series consists of very deep, somewhat excessively drained soils on terraces. These soils formed in sandy glacial outwash and in alluvium that is mixed with eolian material in the upper part. Slope is 0 to 10 percent. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 140 to 200 days.

These soils are sandy, mixed, mesic Xerollic Camborthids.

Typical pedon of Timmerman coarse sandy loam, 0 to 2 percent slopes, about 8 miles west of Moses Lake, 216 feet south and 2,500 feet west of the northeast corner of sec. 13 T. 19 N., R. 26 E.

Ap-0 to 8 inches; brown (10YR 5/3) coarse sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline; abrupt smooth boundary.

B2-8 to 23 inches; pale brown (10YR 6/3) coarse sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and' nonplastic; many very fine roots; common fine tubular pores; mildly alkaline; clear smooth boundary.

C1-23 to 28 inches; light brownish gray (10YR 6/2) loamy coarse sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and

nonplastic; common very fine roots; few fine tubular pores; moderately alkaline; clear smooth boundary.

C2ca-28 to 36 inches; light brownish gray (10YR 6/2) loamy coarse sand, very dark gray (10YR 3/1) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; few fine interstitial and tubular pores; coatings of secondary lime on coarse sand and aggregates of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

C3-36 to 60 inches; very dark gray (10YR 3/1) coarse sand, black (10YR 2/1) moist; single grain; loose; few very fine roots; 10 percent pebbles; moderately alkaline.

Depth to the C horizon and depth to lime range from 13 to 30 inches. The control section ranges from coarse sandy loam to coarse sand, but it averages loamy coarse sand.

The A horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is coarse sandy loam or loamy sand and is neutral or mildly alkaline.

The B horizon has value of 4 to 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is coarse sandy loam or sandy loam and is neutral or mildly alkaline.

The C horizon has value of 3 to 7 when dry and 2 to 5 when moist, and it has chroma of 1 to 3 when dry or moist. It is moderately alkaline or strongly alkaline.

Touhey series

The Touhey series consists of very deep, well drained soils on till plains and plateaus. These soils formed in glacial till that is mixed with loess in the upper part. Slope is 0 to 25 percent. Elevation is 1,600 to 2,600 feet. The average annual precipitation is about 11 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

These soils are coarse-loamy, mixed, mesic Aridic Duric Haploxerolls.

Typical pedon of Touhey very fine sandy loam, 0 to 15 percent slopes, about 7 miles southwest of Electric City, 1,500 feet south and 60 feet east of the northwest corner of sec. 17, T. 27 N., R. 29 E.

Ap-0 to 8 inches; brown (10YR 5/3) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.

A1-8 to 13 inches; brown (10YR 5/3) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.

B2-13 to 27 inches; yellowish brown (10YR 5/4) gravelly very fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; 20 percent pebbles; mildly alkaline; clear smooth boundary.

C1-27 to 34 inches; gray (10YR 5/1) gravelly fine sandy loam, dark gray (10YR 4/1) moist; massive; slightly hard, firm, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; 25 percent pebbles and 5 percent cobbles; moderately alkaline; abrupt smooth boundary.

C2casi-34 to 38 inches; gray (10YR 5/1) discontinuous lenses that are weakly cemented with lime and silica, are 1 /8 to 1 /2 inch thick, and crush to gravelly fine sandy loam, dark gray (10YR 4/1) moist; massive; very hard, firm, nonsticky and nonplastic; common medium pores; 25 percent pebbles, 5 percent cobbles, and 1 percent stones; strongly effervescent; strongly alkaline; clear smooth boundary.

C3-38 to 60 inches; gray (10YR 5/1) gravelly fine sandy loam, dark gray (10YR 4/1) moist; massive; slightly hard, firm, nonsticky and nonplastic; common medium pores; 25 percent pebbles, 5 percent cobbles, and 1 percent stones; strongly alkaline.

Depth to the Ccasi horizon ranges from 25 to 36 inches. The control section is 20 to 35 percent rock fragments.

The B horizon has value of 4 or 5 when dry, and it has chroma of 2 to 4 when dry or moist. It is gravelly loam, gravelly very fine sandy loam, loam, or fine sandy loam.

The C and Ccasi horizons have value of 5 to 7 when dry and 4 or 5 when moist, and they have chroma of 1 or 2 when dry or moist. They are gravelly loam, cobbly loam, or gravelly fine sandy loam. The C3 horizon is moderately alkaline or strongly alkaline.

Umapine series

The Umapine series consists of very deep, somewhat poorly drained, salt- and sodium-affected soils on alluvial plains and in basins. These soils formed in silty alluvium. Slope is 0 to 3 percent. Elevation is 500 to 1,600 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 150 days.

These soils are coarse-silty, mixed (calcareous), mesic Typic Halaquepts.

Typical pedon of Umapine silt loam about 3 miles west of Smyrna, 1,960 feet south and 2,000 feet west of the northeast corner of sec. 31, T. 16 N., R. 25 E.

A11-0 to 4 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate thick platy structure; hard, firm, sticky and plastic; many fine roots; common fine tubular pores; violently effervescent; very strongly alkaline; abrupt smooth boundary.

A12-4 to 9 inches; light brownish gray (10YR 6/2) silt loam, brown (10YR 4/3) moist; moderate medium granular structure; hard, firm, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; violently effervescent; very strongly alkaline; clear wavy boundary.

C1-9 to 24 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; violently effervescent; very strongly alkaline; gradual wavy boundary.

C2-24 to 36 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; violently effervescent; very strongly alkaline; gradual wavy boundary.

C3-36 to 44 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; violently effervescent; very strongly alkaline; clear wavy boundary.

C4g-44 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; common faint dark greenish gray (5G 4/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; violently effervescent; very strongly alkaline.

The control section is strongly alkaline to very strongly alkaline. The profile is calcareous between depths of 10 and 20 inches. The A horizon has value of 5 or 6 when dry and 3 to 5 when moist, and it has chroma of 1 to 3 when dry or moist. The C horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 1 or 2 when dry or moist.

Wahluke series

The Wahluke series consists of very deep, well drained soils on lakebeds and terraces. These soils formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 5 percent. Elevation is 750 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 53 degrees F, and the average frost-free season is 140 to 210 days.

These soils are coarse-silty, mixed (calcareous), mesic Durorthidic Xeric Torriorthents.

Typical pedon of Wahluke very fine sandy loam, 2 to 5 percent slopes, 11 miles southwest of Othello, 960 feet east and 1,800 feet south of the northwest corner of sec. 26, T. 15 N., R. 27 E.

A1-0 to 10 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; moderately alkaline; clear smooth boundary.

C1-10 to 22 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; few aggregates of soft powdery lime; violently effervescent; moderately alkaline; abrupt smooth boundary.

IIC2casi-22 to 28 inches; light brownish gray (2.5Y 6/2) discontinuous lenses that are weakly cemented with lime, are 1/8 to 1/4 inch thick, and crush to very fine sandy loam, dark grayish brown (2.5Y 4/2) very moist; very hard, very firm, slightly sticky and slightly plastic; finely stratified with silt; common very fine tubular pores; nodules that are cemented with lime and lime in pores; violently effervescent; strongly alkaline; clear wavy boundary.

IIC3casi-28 to 44 inches; light brownish gray (2.5Y 6/2) discontinuous lenses that are weakly cemented with lime, are 1/8 to 1/4 inch thick, and crush to silt loam, dark grayish brown (2.5Y 4/2) moist; hard, firm, slightly sticky and slightly plastic; very finely stratified with silt; common very fine tubular pores; lime in pores; violently effervescent; strongly alkaline; abrupt wavy boundary.

IIC4ca-44 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine tubular pores; common spheroidal aggregates of secondary lime; strongly effervescent; strongly alkaline.

Depth to the IICcasi horizon is 15 to 30 inches.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 or 3 when dry or moist. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3 when moist. It is moderately alkaline or strongly alkaline.

The IICcasi and IICca horizons have hue of 2.5Y or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4 when dry or moist. The Cca horizon is moderately alkaline or strongly alkaline and is silt loam or very fine sandy loam.

Wanser series

The Wanser series consists of very deep, poorly drained, salt- and sodium-affected soils on flood plains and in basins. These soils formed in sand derived from

mixed sources. Slope is 0 to 5 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees *F,* and the average frost-free season is 130 to 150 days.

These soils are mixed, mesic Typic Psammaquents.

Typical pedon of a Wanser fine sand in an area of Wanser-Quincy fine sands, 0 to 5 percent slopes, about 5 miles southeast of George, 200 feet north and 860 .feet east of the southwest corner of sec. 25, T. 18 N., R. 24 E.

A1-0 to 3 inches; gray (10YR 5/1) fine sand, dark gray (10YR 4/1) moist; few fine dark reddish brown (5YR 3/4) mottles; single grain; loose; many very fine roots; strongly effervescent; strongly alkaline; clear wavy boundary.

C1g-3 to 9 inches; gray (10YR 5/1) fine sand, dark gray (10YR 4/1) moist; common medium mottles that are dark reddish brown (5YR 3/4) when moist; single grain; loose; common very fine roots; slightly effervescent; moderately alkaline; clear wavy boundary.

C2g-9 to 17 inches; gray (10YR 5/1) fine sand, dark gray (10YR 4/1) moist; many medium and large mottles that are dark bluish gray (5B 4/1) and dark reddish brown (5YR 3/4) when moist; single grain; loose; common very fine roots; moderately alkaline; gradual wavy boundary.

C3g-17 to 32 inches; gray (10YR 5/1) fine sand, dark gray (10YR 4/1) dry; common medium mottles that are dark bluish gray (5B 4/1) when moist; single grain; loose; few very fine roots; moderately alkaline; gradual wavy boundary.

C4g-32 to 60 inches; gray (10YR 5/1) fine sand, dark gray (10YR 4/1) dry; common medium mottles that are dark bluish gray (5B 4/1) when moist; single grain; loose; common very fine roots; violently effervescent; strongly alkaline.

The control section is sand to loamy fine sand and is moderately alkaline or strongly alkaline. The A horizon has value of 5 or 6 when dry and 3 or 4 when moist. The C horizon has value of 3 or 4 when moist. The mottles have hue of 5B or 5YR, and they have value of 4 or 5 when moist. The C horizon is loamy fine sand, fine sand, or sand.

Warden series

The Warden series consists of very deep, well drained soils on terraces. These soils formed in lacustrine deposits that have a mantle of loess. Slope is 0 to 15 percent. Elevation is 800 to 1,300 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the frost-free season is 140 to 170 days.

These soils are coarse-silty, mixed, mesic Xerollic Camborthids.

Typical pedon of Warden silt loam, 2 to 5 percent slopes, about 3/4 mile northwest of Warden, 2,260 feet south and 1,250 feet west of the northeast corner of sec. 8, T. 17 N., R. 30 E.

Ap-0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; mildly alkaline; abrupt smooth boundary.

B1-6 to 10 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; *soft,* very friable, nonsticky and nonplastic; common fine roots; common very fine tubular pores; mildly alkaline; clear wavy boundary.

B2-10 to 17 inches; brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) moist; weak medium and coarse subangular blocky structure; *soft,* very friable, nonsticky and nonplastic; common fine roots; common very fine tubular pores; mildly alkaline; clear wavy boundary.

B3-17 to 26 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; common very fine tubular pores; mildly alkaline; abrupt smooth boundary.

IIC1ca-26 to 35 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; common fine roots; common very fine tubular pores; secondary lime in pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIC2ca-35 to 52 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5 4/2) moist; massive; hard, firm slightly sticky and slightly plastic; common fine roots; common very fine tubular pores; secondary lime in pores; violently effervescent; strongly alkaline; abrupt wavy boundary.

IIC3ca-52 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; *soft,* very friable, nonsticky and nonplastic; few very . fine tubular pores; common spheroidal aggregates of secondary lime; violently effervescent; strongly alkaline.

Thickness of the solum and depth to lime range from 15 to 30 inches. The solum is neutral or mildly alkaline.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. It is very fine sandy loam or silt loam.

The C horizon has value of 6 or 7 when dry and 4 or 5 when moist. It is stratified silt loam or very fine sandy loam.

Wiehl series

The Wiehl series consists of moderately deep, well drained soils on terraces. These soils formed in eolian deposits overlying sandstone or siltstone. Slope is 0 to 35 percent. Elevation is 850 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 140 to 170 days.

These soils are coarse-loamy, mixed, mesic Xerollic Camborthids.

Typical pedon of Wiehl fine sandy loam, 2 to 5 percent slopes, 3 miles southwest of George, 850 feet south and 190 feet west of the northeast corner of sec. 26, T. 18 N., R. 23 E.

Ap-0 to 8 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; mildly alkaline; abrupt smooth boundary.

B2-8 to 18 inches; yellowish brown (10YR 5/4) fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; mildly alkaline; clear wavy boundary.

C1-18 to 25 inches; yellowish brown (10YR 5/4) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; mildly alkaline; abrupt wavy boundary.

Cr-25 inches; weathered red sandstone.

Thickness of the solum is 10 to 18 inches. Depth to the paralithic contact is 20 to 40 inches.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist.

The B horizon has value of 5 or 6 when dry, and it has chroma of 2 to 4 when dry or moist. It is fine sandy loam or very fine sandy loam.

The C horizon has value of 5 to 7 when dry, and it has chroma of 2 to 4 when dry or moist. It is very fine sandy loam or fine sandy loam and is mildly alkaline or moderately alkaline.

Willis series

The Willis series consists of moderately deep, well drained soils on terraces and hills. These soils formed in loess. Slope is 0 to 25 percent. Elevation is 1,400 to 2,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 125 to 140 days.

These soils are coarse-silty, mixed, mesic Orthidic Durixerolls.

Typical pedon of Willis silt loam, 0 to 10 percent slopes, about 9 miles northwest of Ephrata, 120 feet north and 720 feet west of the southeast corner of sec. 6, T. 22 N., R. 25 E.

Ap-0 to 10 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; mildly alkaline; abrupt smooth boundary.

B2-10 to 18 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; moderately alkaline; clear wavy boundary.

C1ca-18 to 23 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine tubular pores; 10 percent cobbles; secondary lime in seams and pores; strongly effervescent; strongly alkaline; clear smooth boundary.

C2casim-23 inches; indurated duripan that is cemented with lime and silica.

Depth to the duripan is 20 to 40 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when dry or moist. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. It is mildly alkaline or moderately alkaline. The C horizon has value of 6 to 8 when dry and 3 to 6 when moist, and it has chroma of 2 or 3 when dry or moist. It is moderately alkaline or strongly alkaline.

Winchester series

The Winchester series consists of very deep, excessively drained soils on hummocky terraces. These soils formed in alluvial and eolian sand. Slope is 2 to 5 percent. Elevation is 500 to 1,800 feet. The average annual precipitation is about 7 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 135 to 180 days.

These soils are mixed, mesic Xeric Torripsamments.

Typical pedon of Winchester sand, 2 to 5 percent slopes, about 6 miles northeast of Royal City, 2,700 feet south and 940 feet east of the northwest corner of sec. 35, T. 18 N., R. 26 E.

C1-0 to 8 inches; grayish brown (10YR 5/2) sand, very dark grayish brown (10YR 3/2) moist; single grain; loose; few fine roots; mildly alkaline; diffuse smooth boundary.
C2-8 to 26 inches; dark gray (10YR 4/1) coarse sand, black (10YR 2/1) moist; single grain; loose; few fine roots; moderately alkaline; gradual wavy boundary.
C3ca-26 to 60 inches; gray (10YR 5/1) coarse sand, very dark gray (10YR 3/1) moist; single grain; loose; few lenses of disseminated lime 1/2 to 3/4 inch thick; slightly effervescent; moderately alkaline.

The C1 horizon is less than 1 percent organic matter. The profile is 0 to 15 percent coarse fragments. It is neutral to moderately alkaline in the upper 20 to 30 inches and is mildly alkaline or moderately alkaline below this depth. The profile has hue of 7.5YR to 2.5Y, value of 4 to 7 when dry and 2 to 5 when moist, and chroma of 1 to 3 when dry or moist.

Zen series

The Zen series consists of moderately deep, well drained soils on ridgetops and hillsides. These soils formed in loess. Slope is 0 to 45 percent. Elevation is 1,500 to 2,900 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

These soils are fine-silty, mixed, mesic Aridic Haploxerolls.

Typical pedon of Zen silt loam, 5 to 25 percent slopes, about 7 miles northeast of Quincy, 1,040 feet west and 1,580 feet south of the northeast corner of sec. 12, T. 21 N., R. 24 E.

Ap-0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; few fine pores; neutral; abrupt smooth boundary.
B1-7 to 13 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine pores; neutral; clear smooth boundary.
B2-13 to 24 inches; yellowish brown (10YR 5/4) heavy silt loam, dark brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine pores; neutral; gradual wavy boundary.
C1-24 to 28 inches; yellowish brown (10YR 5/4) heavy silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; 5 percent pebbles; moderately alkaline; abrupt wavy boundary.
IIR-28 inches; basalt.

The depth to basalt is 20 to 40 inches.

The A horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when moist. It is neutral or mildly alkaline.

The B horizon has value of 4 to 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry. It is neutral or mildly alkaline and is silt loam or silty clay loam.

The C horizon has value of 4 to 6 when dry and 4 or 5 when moist, and it has chroma of 3 or 4 when dry or moist. It is neutral to moderately alkaline.

formation of the soils

Soil is a collection of three-dimensional natural bodies on the earth's surface that supports plants. The properties and characteristics of soil at any given place are determined by soil forming processes that result from (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil accumulated and has existed since accumulation; (3) topography; (4) living organisms; and (5) the length of time the processes of soil formation have acted on parent material.

Soil formation results from a combination of similar processes acting in different proportions and intensities at different times and places on the soil landscape. Processes of soil formation include additions, removals, translocations, and transformations (13). In Grant County, such soil forming factors as accumulation of organic matter, removal of soluble salts, and translocation of carbonates and silicate clay minerals have taken place.

In this section the soil forming factors are discussed separately; however, it should be remembered that there is a strong interdependence among all soil forming factors.

parent material

The nature of soils is strongly influenced by the character of the parent material, particularly by its mineralogy and texture. Mineralogy and texture affect various physical and chemical aspects of the soil forming environment. The soils in Grant County formed in glaciofluvial deposits, loess, lacustrine deposits, eolian sand, colluvium derived from basalt and granodiorite, glacial till, organic material, and recent alluvium. These materials are discussed in the following paragraphs.

Glacial outwash mantled with loess or eolian sand (on terraces and active dunes). Catastrophic floods of glacial melt water from Glacial Lake Missoula 13,000 to 20,000 years ago are the major source of glacial outwash deposits of sand and gravel in the survey area. The floods were diverted southward across the Columbia Plateau when glacial ice dammed the Columbia River. Ice dams storing great volumes of water in Glacial Lake Missoula repeatedly were breached by overflow from the lake. There probably were at least seven successive floods resulting from the bursting of the ice dams, and five of these crossed the Columbia Plateau (2).

Benco, Ephrata, Malaga, Neppel, Strat, and Stratford soils formed in gravelly glacial outwash. The material in the surface layer later became mixed with post-scabland loess. Burbank soils formed in gravelly glacial outwash mantled with eolian sand.

The gravelly glacial outwash deposits south and west of Quincy and areas adjacent to George in the western part of Quincy Basin are the earliest known flood deposits in Grant County. These deposits are pre-Bull Lake in age (more than 50,000 years old). The upper 2 feet is a horizontally laminated duripan that is underlain by 1 to 2 feet of gravel cemented by calcium carbonate (18). This gravel was deposited by eastward flowing floodwater from the Columbia River. The floodwater reached an elevation of about 1,450 feet.

Neppel soils in the. western part of Quincy Basin formed in reworked deposits from the pre-Bull Lake glacial outwash deposits. Hummocky terraces were formed by differential erosion of pre-Bull Lake deposits by floodwater as it increased in velocity near the Columbia River. Other areas of Neppel soils formed in duripan fragments eroded from the Ringold Formation and mixed with outwash from the floods from Glacial Lake Missoula.

Timmerman, Magallon, and Novark soils formed in sandy glacial outwash deposited by slack water of a later flood from Glacial Lake Missoula. The upper part of these soils is mixed with eolian deposits. The sandy glacial outwash overlies gravelly outwash and was deposited on the higher terraces. Novark and Timmerman soils exhibit some influence from post-scabland erosion and deposition.

Chard and Farrel soils formed in poorly sorted glaciofluvial deposits that have a mantle of loess. These glaciofluvial deposits resulted directly from scabland flooding.

Additions of organic matter in the ochric epipedon and development of a mollic epipedon and cambic horizons are the dominant evidence of soil development in soils that formed in glaciofluvial deposits. The Neppel soils also show evidence of cementation by silica; however, cementation is less than that in soils that have a duripan. Burbank soils show little development other than some accumulation of organic matter in the surface layer and some leaching of soluble salts.

Loess (on hills). It has been postulated that the loess that blankets the hills has a complex origin. The primary

deposit was airborne. Local ponding, intermittent streamflow, and sheetwash have played a secondary role in reworking and redepositing the loess.

The Ringold Formation is considered to be the major source of loess older than the Channeled Scablands, but other sources probably have been involved, especially in areas not downwind from any known Ringold deposits. Some loess was probably blown southward from the Cordilleran Ice Sheet as a periglacial phenomenon. The major sources of post-scabland loess were the lacustrine Touchet Beds, glacial outwash deposits, and alluvium along the Columbia River.

Pre-Bull Lake Loess (more than 50,000 years old) and Bull Lake Loess (32,000 to 50,000 years old), if not eroded, have a strongly developed structural B horizon that formed during the early part of interglacial periods when both adequate precipitation and relative warmth prevailed. Drier periods followed when carbonates engulfed the pre-existing B horizon or were deposited on top of the B horizon. Bagdad soils are an example.

Pinedale Loess (6,700 to 25,000 years old) and post-Pinedale Loess (less than 6,700 years old), which are altithermal and post-altithermal are draped over all earlier deposits. Middle Pinedale Loess and post-Pinedale Loess (post-scabland) also occur in some areas of the Channeled Scablands and thus are locally more extensive though thinner than earlier deposits of loess. Mounds in areas of the Channeled Scablands contain both Pinedale and post-Pinedale Loess. The B horizon of middle Pinedale Loess is truncated by post-Pinedale Loess at the outer edges of the mounds.

Pinedale Loess and post-Pinedale Loess contain more volcanic ash than do earlier deposits of loess. Concentrated deposits of volcanic ash include identifiable sand-sized ash from Glacier Peak and silt-sized ash from Mount Mazama. The mineral composition of the loess indicates that this sediment is transported. It contains significant amounts of quartz and potassium feldspar. These minerals are not present in material weathered from basalt.

The loess mantle on hills in the southeastern part of the county is dominantly 10 to 60 feet thick, and in the northern part of the county it is dominantly 5 to 40 feet thick. Adkins, Bagdad, Renslow, Ritzville, and Shano soils formed in areas of deep loess. Burke, Endicott, and Willis soils formed in thin loess overlying a lime- and silica-cemented duripan. In these soils, the lime- and silica-cemented horizons that formed in pre-Bull Lake Loess are distinctively indurated with silica, and those that formed in Bull Lake Loess are less indurated and contain less silica. These soils are in convex areas.

Additions of organic matter in the ochric epipedon and the development of a mollic epipedon and cambic and argillic horizons are the dominant evidence of soil development. Adkins, Ritzville, and Shano soils have cambic horizons; they are nearer sources of post-scabland loess and, consequently, have thicker deposits of it than do Renslow and Bagdad soils. Renslow and Bagdad soils have thin layers of post-scabland loess. The older underlying loess has been near the soil surface, where soil forming processes have been more active for a long period of time. Consequently, Renslow and Bagdad soils have an argillic horizon.

Loess, colluvium, weathered basalt, and weathered granodiorite (on benches, hillsides, and ridgetops). The oldest geologic material in Grant County is granite. During Cretaceous time (65 to 136 million years ago) deformation and implacement of granite intrusion took place (10). Exposures of granitic rock in Grant County are located near Electric City and Grand Coulee. These granite intrusions were buried by lava flows during Miocene time (12 to 28 million years ago), but later they were exposed by the floods of glacial melt water from Glacial Lake Missoula.

During the Miocene and continuing well into the Pliocene (1.5 to 12 million years ago), many extensive lava flows from fissure eruptions flooded Grant County. Individual lava flows vary from a few dozen feet in thickness to more than 100 feet. The total thickness of the Columbia River Basalt exceeds 10,000 feet in places (8).

Pliocene time was the beginning of the anticlinal folding (deformation of basalt) in the Yakima Folds province, which produced large ridges such as the Saddle Mountains and Frenchman Hills. The Beezley Hills uplift began before the cessation of lava flows and the folding of Saddle Mountains and Frenchman Hills.

Anders, Condon, Prosser, Roloff, and Zen soils formed in loess overlying basalt. Badge, Kiona, and Ralls soils formed in colluvium derived from loess and basalt. Bakeoven, Lickskillet, and Starbuck soils formed in loess and material weathered from basalt and are overlain by basalt. Entiat soils formed in loess and material weathered from granodiorite and are underlain by granodiorite.

Lacustrine deposits (on terraces and active dunes). The origin of the lacustrine or slack-water deposits postdating the floods from Glacial Lake Missoula have long been controversial. Recent field evidence suggests that some deposits were laid down during scabland flooding (glaciofluvial deposits), whereas others were laid down during various other events. The later deposits (Touchet Beds) may have been deposited in one or more extensive lakes. The deposits are at least 10,000 years old and are believed to postdate the last major episode of scabland flooding; however, Waitt (17) suggests that 40 late Wisconsin floods deluged the region. His hypothesis is that each rhythmite of the Touchet Beds represents a separate backflooding by ponded water of Glacial Lake Missoula. Ice-rafted erratics and clastic dikes are common. The lower part of the deposits is characteristically fine bedded, well laminated, and generally silty, and it includes three layers

of volcanic ash from Mount St. Helens. The upper part of the deposits is stratified and is not well laminated.

Sagehill and Warden soils formed in stratified lacustrine deposits that are not well laminated and have a loess mantle. Ellisforde, Hezel, Kennewick, Sagemoor, and Wahluke soils formed in well laminated lacustrine deposits that are fine bedded. Ellisforde, Sagemoor, and Wahluke soils have a loess mantle. The Hezel soils have a mantle of eolian sand. Ellisforde soils in the Banks Lake area formed in well laminated lacustrine sediment that probably was deposited by Glacial Lake Columbia.

*Eolian sand (on terraces and active dunes). Post-*glacial or Holocene (less than 11,000 years ago) modification of the landscape by wind produced extensive areas of sand dunes. These developed from lacustrine sand, deflation of outwash and lacustrine deposits, sandy flood deposits and from recent sandy alluvial bars on the Columbia River.

Quincy soils formed in eolian sand overlying lacustrine sand or sandy glacial outwash on terraces and in eolian sand of dunes on terraces. Winchester soils formed in sandy glacial outwash and eolian sand. Quincy and Winchester soils show little development other than some accumulation of organic matter in the surface layer and some leaching of soluble salts and carbonates.

Loess, alluvium, and eolian sand (on old lacustrine terraces and piedmont slopes). During Pliocene time, the rising of Horse Heaven Hills (south of the survey area) reduced the gradient of the Columbia River and tributary streams. This reduced gradient resulted in deposition of the Ringold Formation (5). The Ringold Formation is considered to represent a period of sedimentation continuing beyond the emission of the latest basalt flows (3). The sediment that accumulated prior to the emission of the latest basalt flows is known as the Ellensburg Formation.

Gravelly alluvial deposits that interfinger into the Ringold Formation are known as fanglomerates. They were deposited contemperaneously with the main body of the Ringold Formation. The piedmont slopes are mainly on the south-facing foot slopes of the Saddle Mountains and Beezley Hills.

During the Pliocene and early Pleistocene, the Cascade Range was uplifted, causing a gradual shift from semihumid to semiarid climate. The drier climate is recorded in the gradual increase in calcareousness and cementation of the Ringold surface. The cemented surface is as much as 20 feet thick (6). The cemented calcareous surface of the Ringold Formation and the piedmont slopes now forms the duripan of the Ekrub, Koehler, Scoon, and Taunton soils.

Taunton soils formed in loess and alluvium overlying a lime- and silica-cemented duripan. Scoon and Willis soils formed in loess overlying a lime- and silica-cemented duripan. Ekrub and Koehler soils formed in eolian sand overlying a lime- and silica-cemented duripan. In some places, floods from Lake Missoula scoured the surface of the duripan, exposing sandstone or siltstone. This helps to account for some of the variation in the thickness of the duripan. Wiehl soils formed in eolian deposits overlying sandstone and siltstone sediment of the Ringold Formation. The duripan was removed by floods.

Additions of organic matter in the ochric epipedon and development of a mollic epipedon and cambic horizons are the dominant evidence of soil development after the formation of the duripan in the Scoon, Taunton, and Willis soils. Ekrub and Koehler soils show little development after the formation of the duripan, except for some accumulation of organic matter in the surface layer and some leaching of soluble salts and carbonates. Accumulation of organic matter in the surface layer and development of cambic horizons are the dominant evidence of soil development in the Wiehl and Finley soils.

Glacial till and loess (on till plains). The Waterville Plateau, which includes the area in Grant County west of Banks Lake, was glaciated by the Okanogan lobe of the Cordilleran ice sheet during the Pleistocene glacial advances. There were two glacial advances during Pinedale time (6,600 to 25,000 years ago), and they are regarded as the early and middle stages of the Pinedale Glaciation (12). These advances of the Okanogan lobe, formed ice dams that impounded Glacial Lake Columbia both before and after the floods. A readvance of the Okanogan lobe occurred after the floods had passed through the Grand Coulee.

The Timentwa and Touhey soils on till plains formed in glacial till mixed with loess in the upper part. The undulating surface of the till plains is marked by an occasional very large boulder known locally as haystack rocks.

Touhey and Timentwa soils have a mollic epipedon and cambic horizons, which are the dominant evidence of soil development. Both soils have lenses that are weakly cemented with lime and silica.

Alluvial and organic deposits (on flood plains and in basins and other depressional areas). Post-glacial, or Holocene, (less than 11,000 years ago) modifications of the landscape include very localized deposition of alluvium. Saltese soils formed in remains of plants with a minor amount of alluvium. They formed in areas where the ground water level tends to fluctuate within the soil, allowing periodic aerobic decomposition of organic material.

Outlook, Umapine, and Wanser soils show little development other than the accumulation of organic matter in the surface layer and the accumulation of soluble salts. Cleman, Esquatzel, Hermiston, Kittitas, and Pedigo soils have a mollic epipedon presumably inherited from the alluvial parent material. These soils have an irregular decrease in organic matter content with depth. Ahtanum soils have a mollic epipedon and a weak duripan.

climate

Climate is an active factor in soil formation. The primary climatic factors in soil formation are temperature and precipitation. As elevation increases, precipitation generally increases and temperature decreases. Grant County lies within the rain shadow formed by the Cascade Mountains. The southern part of the county is influenced more by the rain shadow than is the northern part of the county.

Climate affects soil formation by its influence on weathering, organic matter production and decomposition, leaching, and erosion. Besides influencing the kind of vegetation, it also influences the density of plants that grow in an area.

The period in which biological and chemical activity is operational depends on the length of time soils are moist and have favorable temperatures. Soils in this area have aridic and xeric moisture regimes. Thus, these soils are not always moist when favorable temperatures prevail. The moisture regime depends on the amount and timing of precipitation and on the soil characteristics. Temperature is a measure of heat that is available for the chemical, physical, and biological reactions involved in soil development. If water is not a limiting factor, the rate of mineral weathering increases with the temperature. Higher temperatures also hasten decomposition of organic matter by oxidation and consequently reduce the organic matter content.

The kind and degree of eluviation depend on the amount of water percolating through the soil under present and past climatic conditions. This is reflected in the soil characteristics. Percolation is influenced by the amount of precipitation, by the rate of evapotranspiration, and by the length of the frost-free period. A high evapotranspiration rate in the aridic moisture regime impedes leaching, and under some conditions it can cause upward movement of some soluble salts.

In Grant County there are three major areas in which the influence of the climate on soil genesis varies. In the southern part of the county, the climate is characterized by hot, dry summers and cool, moist winters. These conditions have given rise to soils with an aridic moisture regime that borders on xeric. The average annual precipitation is about 7 inches, and the average annual temperature is 50 to 53 degrees F. Precipitation is adequate to leach the more soluble salts. Most of the precipitation falls during the cold winter months, and the annual moisture supply is exhausted early in the growing season. Because the soils are dry when they are warm, chemical weathering is slow. Under this environment, slight accumulation of organic matter and limited leaching have occurred. Cambic horizons are weakly expressed. Shano, Warden, Kennewick, and Burbank soils are examples.

In the northern half of the county, the climate is characterized by warm, dry summers and cool, moist winters. The soils in this area have an aridic moisture regime that borders on xeric. The average annual precipitation is about 10 inches, and the average annual temperature is 49 to 50 degrees F. This environment produces enough plant growth for the development of a mollic epipedon. Leaching in this area is greater than that in the southern part of the county, which has resulted in deeper leaching of carbonates. The cambic horizon is more strongly expressed and structure is more pronounced than in soils in the southern part of the county. Some soils in the northern part of the county have a weakly expressed argillic horizon. Strat, Stratford, and Renslow soils are examples.

In the extreme northern part of the county, the climate is characterized by warm, dry summers and cool, moist winters. The soils in this area have a xeric moisture regime. The average annual precipitation is about 12 inches, and the average annual air temperature is about 47 to 48 degrees F. This environment produces enough plant growth for the development of a mollic epipedon with higher organic matter content than that in areas with an aridic moisture regime. Leaching in this area is greater than in areas with an aridic moisture regime, which has resulted in deeper leaching of carbonates. The cambic and argillic horizons are more strongly developed and structure is more pronounced than in soils in other parts of the county. Anders, Condon, and Bagdad soils are examples.

Past climatic conditions in Grant County, especially during the Pleistocene, alternately favored profile formation and profile destruction or burial. Soil profiles developed during periods when sedimentation or erosion proceeded more slowly than soil forming processes. Frye (4) suggested that glacial intervals were periods of soil destruction or burial and that interglacial intervals of the Pleistocene were periods of soil formation. Soil was often destroyed down to the resistant duripan or clay-rich B horizon.

Some relict soil features reflect former, more moist climates. Former periods of freezing temperatures resulted in frost-sorting and solifluction (9). Solifluction occurs when the ground is frozen part of the year, during which interstitial ice and lenses of ice form. When the soils thaw, they settle with a resultant downslope displacement. Some soils such as those of the Ralls series have stone lines that can be related to periods of erosion and deposition during solifluction movements. Kaatz (7) maintained that intense frost action during periods of periglacial climate was more significant in the development of the patterned ground in central Washington than had been recognized previously. He suggested that the mounds called biscuits formed in areas where the soil mantle is less than 6 feet deep, which provided conditions favorable for the formation of ice-wedge polygons. Mounds are in areas of the

Channeled Scablands on outwash terraces and on basalt benches. Strat and Strafford soils and complexes of Malaga and Ephrata soils are in areas of patterned ground. Ephrata and Strafford soils are on mounds, and Malaga and Strat soils are between the mounds.

topography

The topography influences soil formation through its effects on drainage, erosion, depth of the soil, penetration of water into the soil, microclimate of the soil, and the amount and type of vegetation that grows on the soil. Elevation, slope, position, and aspect are also important elements of topography.

Much of the water that falls on soils percolates through them, and some evaporates. In sloping to steep areas, runoff generally increases with increasing slope. The more water that enters the soil, the greater the depth to which the soil is leached and weathered. The topography, which produces variations in exposure to the sun and wind and in air drainage, can create noticeable differences in vegetation and soil properties. For example, south-facing slopes receive more direct radiation from the sun than do the north-facing slopes. Consequently, south-facing slopes are warmer and drier.

Aspect also influences the amount of loess that accumulates. South- and southwest-facing slopes are exposed to the prevailing wind, and thus the accumulation of loess on them is less than on north-facing slopes. Also because of the higher evapotranspiration rate on south- and southwest-facing slopes, plant density is less than on north-facing slopes. With a lower plant density, the potential for water erosion is greater on south- and southwest-facing slopes. Representative soils on convex south- and southwest-facing slopes are the moderately deep Burke soils. Examples of soils on north-facing slopes are the very deep Shano soils.

Local relief modifies the moisture regime of soils. This is especially evident in soils on bottom lands. Runoff water from adjacent upland soils accumulates on bottom lands, and a seasonal high water table is common in some of the soils. Examples of soils that are somewhat poorly drained are Kittitas and Wanser soils.

Some well drained soils on bottom lands are Esquatzel and Cleman soils.

In some areas where the free water in the soil contains salts and is sufficiently close to the surface, evapotransportation concentrates the salts in the surface layer. Included among these soils are those of the Kittitas, Outlook, Umapine, and Wanser series.

living organisms

Living organisms are active in the formation of soils. Plants, micro-organisms, earthworms, man, and other forms of life are important in determining the rate and direction of soil formation. Accumulation of organic matter, nutrient cycling, profile mixing, and structural stability are all made possible by the presence of organisms in the soil. Further, nitrogen is added to the soil system by micro-organisms alone or in association with plants. The kinds and abundance of organisms that live on or in the soil at any given location are determined by climate, parent material, topography or relief, and the age of the soil.

Plants provide a cover that reduces runoff and erosion and helps to stabilize the soil surface, which can have an important bearing on the rate of soil development. Plant roots penetrate the earth's mantle and improve the permeability and aeration of the soil.

In Grant County, the soils formed in two major vegetation zones. These are the big sagebrush-bluebunch wheatgrass zone and the threetip sagebrush-Idaho fescue zone. These stable plant communities generally grow on moderately deep to very deep, well drained, medium textured soils.

The big sagebrush-bluebunch wheatgrass zone is in areas of soils with an aridic moisture regime. The average annual precipitation in these areas is about 7 inches. The plant community produces less organic matter than areas with higher precipitation, which results in the development of soils with an ochric epipedon. Shano soils are an example. In the areas that receive an average annual precipitation of about 10 inches, the plant community produces more organic matter than that in areas with lower precipitation, which results in the development of a mollic epipedon. Ritzville soils are an example.

The threetip sagebrush-Idaho fescue zone is mainly in areas of soils with a xeric moisture regime. The average annual precipitation is about 12 inches. Soils that have formed under this plant community have a higher organic matter content than those that formed in the big sagebrush-bluebunch wheatgrass zone. A mollic epipedon has developed in these soils. Bagdad soils are an example.

Edaphic climaxes occur on very shallow and shallow soils, on moderately coarse textured soils, on soils that have poor drainage, on saline-sodic soils, and on soils that have carbonates at or near the surface. Topographic climaxes occur on soils that have special microclimates such as those that are steep and face north.

Man's influence in Grant County has been considerable. Since the advent of irrigation, for example, overirrigation of soils in the higher lying areas has produced saline-sodic soils in the lower lying areas. Outlook soils are examples. Because of irrigation, land leveling, soil erosion, and alteration of native plant communities, man's presence will remain a highly significant soil forming factor in the county.

time

Soil formation begins when rock is exposed on the earth's surface, sediment appears above the water, or a fresh mantle of loess is laid down. As soil formation progresses, characteristic layers (called horizons) develop. Generally, the greater the number of horizons and the greater their thickness and distinctness, the more mature is the soil. The length of time required for a soil to develop depends on the nature of the parent material and the intensity of the soil forming factors.

The parent material in Grant County is granite of Cretaceous age; basalt of Miocene and Pliocene age; material of the Ringold Formation and fanglomerate of Pliocene age or early Pleistocene age; loess and outwash of pre-Bull Lake age; loess and colluvium of Bull Lake age; loess, glacial till, glacial outwash, lacustrine deposits, colluvium, and volcanic ash of Pinedale age; loess of post-Pinedale age; and alluvium, eolian sand, colluvium, and volcanic ash of post-glacial or Holocene age.

Diagnostic horizons in soils of Grant County have been forming since the late Pliocene or early Pleistocene. Duripans formed in the Ringold Formation and fanglomerates during that time. Duripans that formed in younger glacial outwash deposits of pre-Bull Lake age are thinner than those that formed in older deposits. Most of these soils since have been eroded to the duripan. Loess, alluvium, and eolian sand have been deposited in Pleistocene and Holocene time over the old duripan, and new soils are forming. Scoon and Taunton soils are examples of soils that formed over an older duripan. An argillic horizon has formed predominantly in soils derived from parent material of Bull Lake age. Renslow and Bagdad soils are examples of soils that have an argillic horizon. Cambic horizons have formed in soils derived from parent material of Pinedale age. Shano and Ritzville soils are examples.

The youngest soils in the county formed in alluvium on flood plains and are subject to flooding. These soils are so young that they show little development other than the accumulation of organic matter in the surface layer. Cleman and Esquatzel soils are examples.

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glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as-

	Inches
Very low	0 to 2.0
Low	2.0 to 3.75
Moderate	3.75 to 5.0
Moderately high	5.0 to 7.5
High	More than 7.5

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channeled Scablands. A geographic area of unique landscape features, soil profiles, and relief. The area has elongated, bedrock controlled erosional features that are assumed to have been caused by flooding of glacial melt water. Many tens of feet of loess were removed by floodwater and the area scoured to bedrock in many places, leaving behind a unique pattern of channels, pools, basins, and other features.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are
Loose. -Noncoherent when dry or moist; does not hold together in a mass.
Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.-When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.-When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.-When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.-When dry, breaks into powder or individual grains under very slight pressure.
Cemented.-Hard*;* little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained. -Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.-Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.-Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.-Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.-Water is removed slowly enough that the soil is wet for significant periods during the growing' season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.-Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.-Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy

material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep. *Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion. *Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

High-residue crops. Crops such as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.-An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.-The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B

horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation . application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are-

Corrugation.-Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).-Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance-few, *common,* and *many, size-fine, medium,* and *coarse;* and contrast-faint, *distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6. inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables-hue, value, and chroma. For example, a notation of 1 OYR 6/4 is a color of 1 OYR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting (in tables). Pits caused by melting ground ice. They form on the soil after plant cover is removed.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as-

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slope length. The distance from the point of origin of overland flow to the point where either the slope gradient decreases enough that deposition begins or the runoff water enters a well-defined channel that may be part of a drainage network or a constructed channel.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Small grain residue left on the surface of the soil over a two year period. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsolling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from

4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.