

This is a scanned version of the text of the original Soil Survey report of Whitman County, Washington issued April 1980. Original tables and maps were deleted. There may be references in the text that refer to a table that is not in this document.

Updated tables were generated from the NRCS National Soil Information System (NASIS). The soil map data has been digitized and may include some updated information. These are available from <http://soildatamart.nrcs.usda.gov>

Please contact the State Soil Scientist, Natural Resources Conservation Service (formerly Soil Conservation Service) for additional information.

SOIL SURVEY OF WHITMAN COUNTY, WASHINGTON

By Norman C. Donaldson, Soil Conservation Service

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United States Department of Agriculture, Soil Conservation Service, in cooperation with Washington State University Agricultural Research Center

WHITMAN COUNTY is in the southeastern part of Washington (fig. 1). It has an area of 1,385,370 acres. Most of the county has a rolling to hilly topography and deep soils that formed in silty material deposited by wind. Basalt is the base rock, but there are a few promontories of quartzite, shale, and sandstone. Elevation is about 4,000 feet in Tekoa Mountain, the highest part of the county.

Channeled scablands (3) in the western part of the county consist of a broad basalt plateau that was stripped of soil by glacial floodwaters. Many islandlike remnants of preglacial soils remained after the glacial floods. Channels that run in a southwest direction were cut in the basalt bedrock. Some are now occupied by potholes and lakes. Bonnie and Rock Lakes are in this area.

Most of the survey area drains into the Palouse River and its tributaries. The Palouse River heads in the mountains of Idaho adjacent to the eastern boundary of the county, and the north and south forks of the river converge near the center of the county at Colfax. It flows west and south from Colfax to its junction with the Snake River at the extreme southwest corner of the survey area. Principal tributaries of the Palouse River include Rock, Pine, and Cottonwood Creeks in the northern and northwestern parts of the survey area and Union Flat, Rebel Flat, and Willow Creeks in the southern and southwestern parts.

The southern part of the survey area consists of a narrow band of very steep soils along the Snake River Canyon that drain directly into the Snake River.

Hangman Creek, a perennial tributary to the Spokane River, drains an area of about 20 square miles in the northeastern part of the county. Its drainage water ultimately flows into the Columbia River.

Wheat is the major cultivated crop. Barley, peas, lentils, grass, and alfalfa are other important crops. Soils on the breaks of the Snake River, on the channeled scablands, and on the buttes are used mostly for range and wildlife habitat.

Others who contributed to the soil survey are JOHNATHAN P. EDWARDS, JACK L. WOOD, DALE L. OLSON, CLINTON B. LEONARD, PAUL E. RASMIUSSEN, BERT J. JAHN, and PHILLIP S. GALE.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Whitman County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in nearby counties and in more distant places. They classified and named the soils according to nationwide, uniform procedures.

Soils that have similar profiles make up a soil series. Except for different texture in the surface layer, all



Figure 1.-Location of Whitman County in Washington.

the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series generally is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Palouse and Naff, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Tekoa silt loam, 3 to 25 percent slopes, is one of several phases within the Tekoa series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit is the soil complex.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Anders-Kuhl complex, 3 to 15 percent slopes, is an example.

In most areas surveyed there are places that have not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous areas and are given descriptive names. Rock outcrop is an example.

While a soil survey is in progress, the scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage

fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows the soil associations in Whitman County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

In order to show the relation of soils to landforms, a block diagram was made with the aid of a computer for each soil association.

The soil associations in the survey area have been grouped into five general kinds of landscapes for broad interpretative purposes. Each of the groups and their included soil associations is described in the following pages.

Very Deep Soils Formed in Loess on Uplands

This group is on hills and ridges on uplands. Elevation ranges from 1,200 to 3,000 feet. The average annual precipitation ranges from 11 to 23 inches.

Most of the soils in this group are used for dryland farming.

The seven associations in this group make up about 64 percent of the county.

1. Walla Walla association

Well drained, moderately permeable silt loams are

dominant in this association. This association is in the western part of the county. Parts of the association are surrounded by channeled scabland. The topography is fairly smooth and consists mainly of a series of hills that are roughly parallel to each other, are oriented in a northeast-southwest direction, and are separated by U-shaped draws (fig. 2). The hills have broad, slightly rounded, gently sloping to moderately steep tops and steep to very steep sides. Total relief of individual hills is 50 to 120 feet. The area is slightly to moderately dissected, and the drainage pattern is mainly subparallel. Annual precipitation is 11 to 15 inches. Elevation ranges from 1,200 to 2,200 feet.

This association makes up approximately 14 percent of the county. Walla Walla soils make up about 82 percent of the association; Risbeck soils about 6 percent; Chard, Ritzville, Endicott, Walvan, and Athena soils about 7 percent; Onyx and Hermiston soils about 3 percent; and small areas of other soils about 2 percent.

Walla Walla soils occupy most areas on the hills except the south-facing side slopes, narrow ridgetops, and some of the north- and northeast-facing side slopes. Typically, Walla Walla soils have a dark grayish brown and grayish brown silt loam surface layer about 16 inches thick, a brown and pale brown silt loam subsoil extending to a depth of 41 inches, and a pale brown silt loam substratum. In places the substratum is calcareous in the lower part.

Risbeck soils are on south-facing upper side slopes. Chard soils are on outwash terraces adjacent to channeled scablands. Ritzville soils are on south-facing side slopes in the southeastern part of the association. Endicott soils are on long narrow ridgetops, south-facing side slopes, and low-lying broad benches. Walvan soils are on the north- and northeast-facing side slopes. Athena soils are on north-facing side slopes along the eastern edge of the association. Onyx and Hermiston soils are nearly level and are in narrow drainageways and on alluvial fans.

The remaining soils in this association are dominantly deep, well drained silt loams. Hermiston soils have a strongly alkaline substratum, Chard soils have a fine sandy loam substratum, and Endicott soils have a hardpan.

Practically all areas of the nearly level to steep soils are farmed. Wheat, barley, grass, and alfalfa are the principal crops. Summer fallow is used because the annual precipitation is too low to make annual cropping feasible. Most areas of the very steep soils are small and isolated. They are unfenced and are used for wildlife habitat and range.

2. Athena association

Well drained, moderately permeable silt loams are dominant in this association. This association is dominantly in the western part of the county, east of the

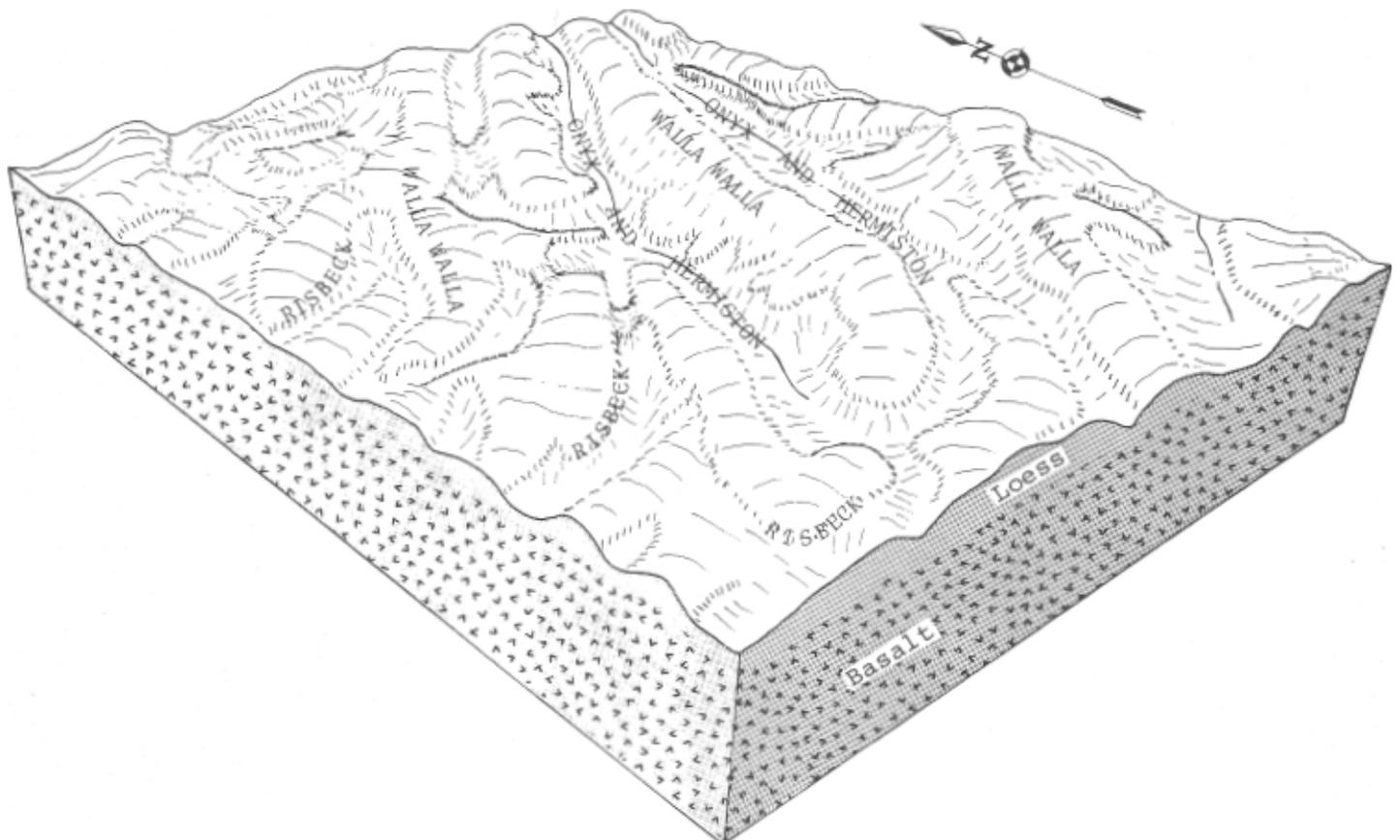


Figure 2.-Typical landscape in the Walla Walla association.

Walla Walla association. It also is in the southeastern part of the county. The topography is fairly smooth and consists chiefly of a series of main hills or ridges and numerous small spur ridges extending outward from them (fig. 3). The hills and ridges are separated by U-shaped draws. The ridges have slightly rounded, gently sloping to moderately steep tops and moderately steep to very steep sides. The north- and northeast-facing sides are generally shorter and steeper than the south- and west-facing sides. Total relief of individual hills is 60 to 200 feet. The area is slightly to moderately dissected, and the drainage pattern is subparallel. Annual precipitation is 15 to 18 inches. Elevation ranges from 1,600 to 3,000 feet.

This association makes up approximately 12 percent of the county. Athena soils make up about 84 percent of the association; Lance and Calouse soils about 12 percent; Mondovi, Covello, Hermiston, and Pedigo soils about 2 percent; Palouse and Thatuna soils about 1 percent; and small areas of other soils about 1 percent.

Athena soils occupy most areas on the hills. Typically, Athena soils have a dark grayish brown and grayish brown silt loam surface layer about 20 inches thick, a brown and pale brown silt loam subsoil extending to a depth of 48 inches, and a light gray calcareous silt loam substratum.

Lance and Calouse soils are on south-facing upper

side slopes and narrow ridgetops. Mondovi, Hermiston, Covello, and Pedigo soils are in narrow drainageways and on alluvial fans. Palouse and Thatuna soils are on north- and northeast-facing side slopes at the eastern edge of this association.

The remaining soils in this association are dominantly deep silt loams. Lance soils are calcareous at or near the surface; Covello, Pedigo, and Thatuna soils have restricted drainage; and Thatuna soils have a silty clay loam subsoil. Hermiston and Pedigo soils are strongly alkaline.

Practically all areas of the nearly level to steep soils are farmed. Wheat, barley, peas, alfalfa, and grass are the principal crops. A farming system of annual cropping and intermittent fallow is used. Most areas of the very steep soils are small and isolated. They are unfenced and are used for wildlife habitat and range.

3. Athena-Calouse association

Well drained, moderately permeable silt loams are dominant in this association. This association is in the central part of the county, east of the Athena association, and in a small area in the southeastern part. The topography is fairly smooth and consists chiefly of irregularly oriented hills or ridges (fig. 4). The hills are separated by U-shaped and V-shaped draws. The hilltops are slightly rounded and are gently sloping to strongly sloping. In places are sharp-topped ridges

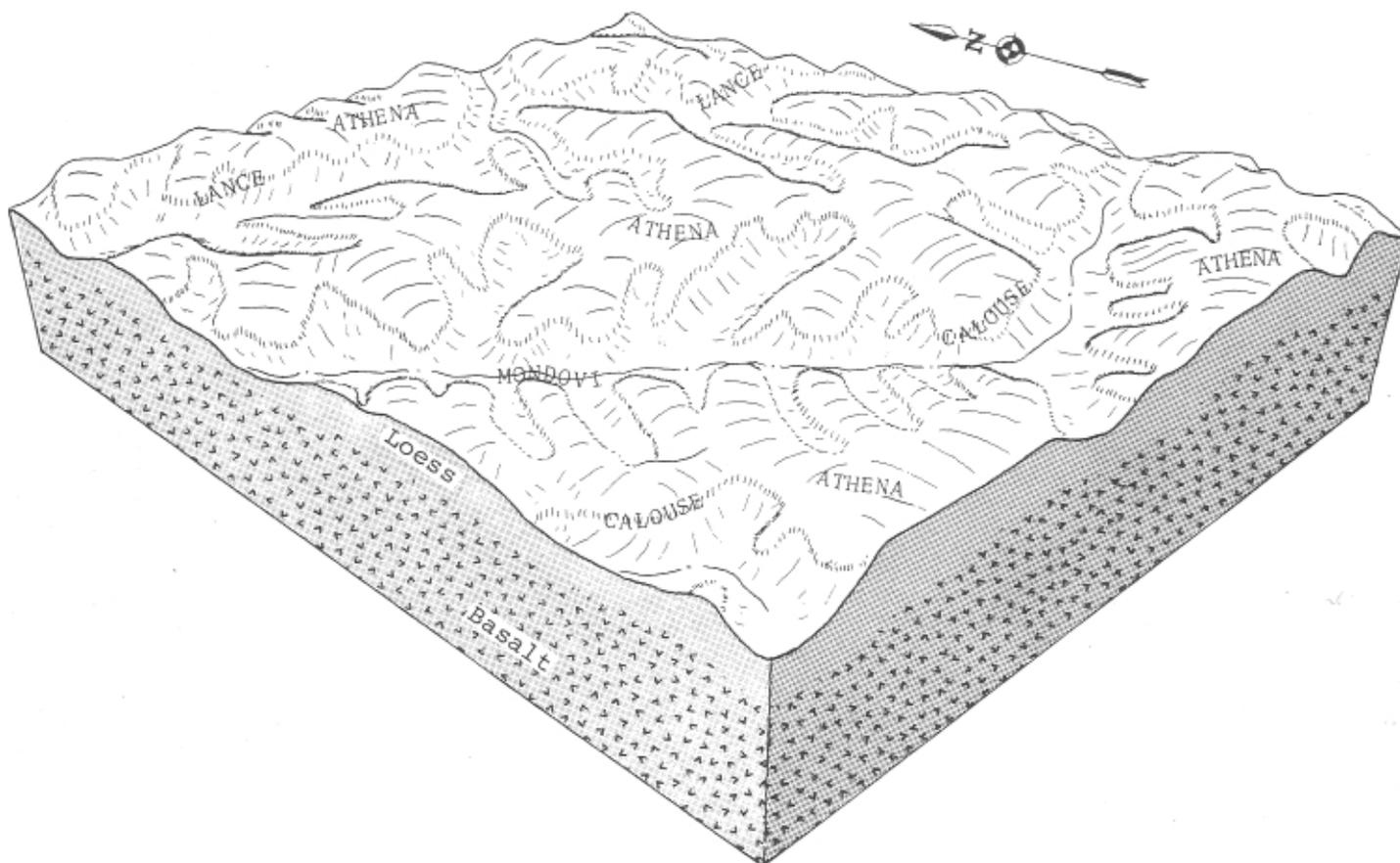


Figure 3.-Typical landscape in the Athena association.

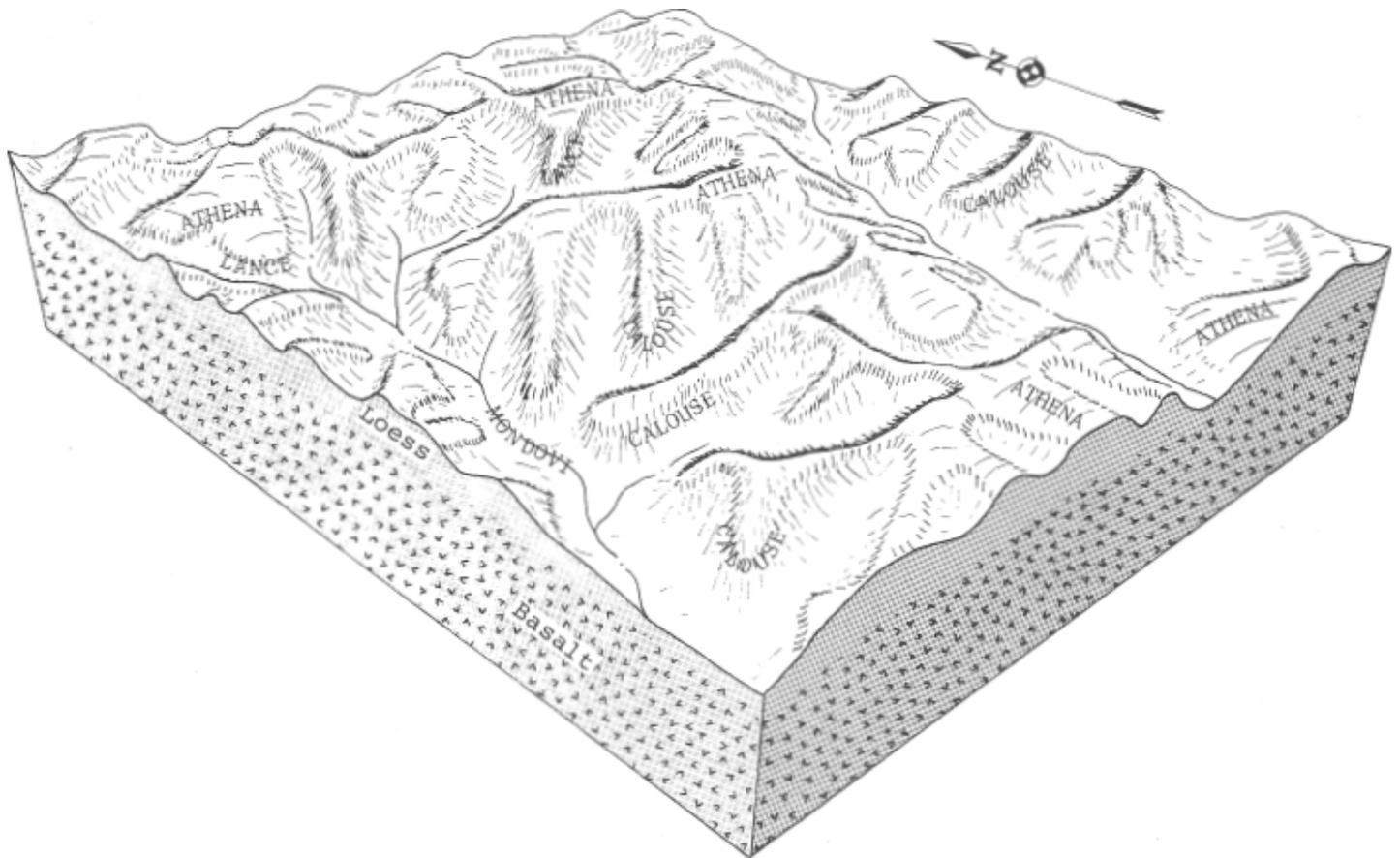


Figure 4.-Typical landscape in the Athena-Calouse association.

that have cirquelike amphitheater enclosures on the northern sides. The sides of the hills are moderately steep to very steep. The north- and northeast-facing sides are generally shorter and steeper than the south- and west-facing sides. Total relief of individual hills is 100 to 220 feet. The area is intensely to very intensely dissected, and the drainage pattern is subparallel and dendritic. Annual precipitation is 16 to 18 inches. Elevation ranges from 1,850 to 2,900 feet.

The association makes up approximately 6 percent of the county. Athena soils make up about 74 percent of the association; Calouse and Lance soils about 17 percent; Palouse, Uhlig, Snow, and Thatuna soils about 6 percent; Mondovi and Covello soils about 2 percent; and small areas of other soils about 1 percent.

Athena soils occupy most areas on the hills except the south-facing upper side slopes and narrow ridgetops. Typically, Athena soils have a dark grayish brown and grayish brown silt loam surface layer about 20 inches thick, a brown and pale brown silt loam subsoil that extends to a depth of 48 inches, and a light gray, calcareous silt loam substratum.

Typically, Calouse soils are on south-facing upper side slopes and on narrow ridgetops. Calouse soils have a dark grayish brown silt surface layer about 12 inches thick, a brown silt loam subsoil extending to a depth of 32 inches, and a light gray and pale brown, calcareous silt loam substratum.

Lance soils are on south-facing upper side slopes and on narrow ridgetops. Palouse and Thatuna soils are on north- and northeast-facing side slopes at the eastern edge of this association. Uhlig soils are on outwash terraces adjacent to channeled scablands. Snow soils are on terraces and foot slopes. Mondovi and Covello soils are in narrow drainageways and on alluvial fans.

The remaining soils in this association are dominantly deep silt loams. Lance soils are calcareous throughout, Thatuna and Covello soils have restricted drainage, and Thatuna soils have a silty clay loam subsoil.

Practically all areas of the nearly level to steep soils are farmed. Wheat, barley, peas, alfalfa, and grass are the principal crops. A system of annual cropping and intermittent fallow is used. Most areas of the very steep soils are small and isolated. They are unfenced and are used for wildlife habitat and range.

4. Palouse association

Well drained, moderately permeable silt loams are dominant in this association. This association is mainly in the central part of the county, east of the Athena-Calouse association. A small area is in the southeastern part of the county. The topography consists of a series of irregularly oriented hills and ridges separated by U-shaped draws (fig. 5). The hilltops are mostly

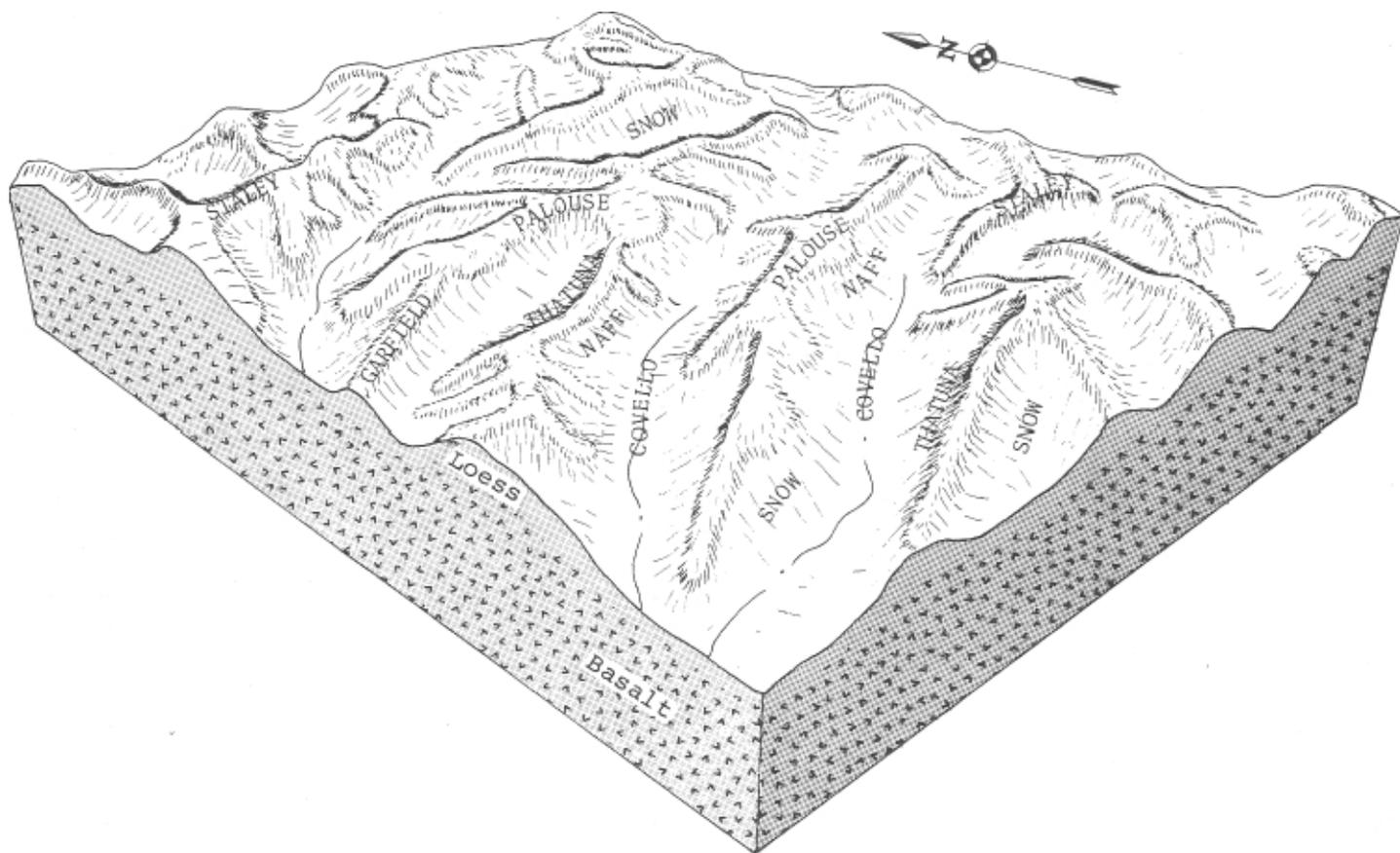


Figure 5.-Typical landscape in the Palouse association.

narrow and gently sloping to strongly sloping. Some have rather sharp tops. Cirquelike amphitheater enclosures are on northern sides of the hills in places. The side slopes are moderately steep to very steep. In some places they are fairly smooth and uniform, but in other places they are rough and irregular. Side slopes facing north and northeast are generally shorter and steeper than those facing south and west. Total relief of individual hills is 100 to 240 feet. The area is intensively to very intensively dissected, and the drainage pattern is subparallel and dendritic. Annual precipitation is 18 to 21 inches. Elevation ranges from 2,100 to 2,900 feet.

This association makes up approximately 5 percent of the county. Palouse soils make up about 69 percent of the association; Thatuna soils about 11 percent; Naff and Snow soils about 9 percent; Staley and Garfield soils about 7 percent; Covello, Latah, and Caldwell soils about 3 percent; and small areas of other soils about 1 percent.

Palouse soils are on south-facing side slopes, convex north-facing side slopes, and very small, oval, rather flat hilltops. Typically, Palouse soils have a dark grayish brown and grayish brown silt loam surface layer about 24 inches thick and a pale brown silt loam subsoil extending to a depth of 60 inches.

Thatuna soils are on concave and smooth, uniform, north- and northeast-facing side slopes. The larger areas of Naff soils are on south-facing sides of lower

lying hills, and the smaller areas are on low-lying shoulders, knobs, and interconnecting ridges, mainly in the southeastern part of the association. Snow soils are on terraces and foot slopes. Staley soils are on narrow ridgetops. Garfield soils are on low-lying shoulders, knobs, saddles, and ridges, mainly in the southeastern part of the association. Covello, Latah, and Caldwell soils are in narrow drainageways and on alluvial fans.

The remaining soils in this association are dominantly deep silt loams. Thatuna, Caldwell, Latah, and Covello soils have restricted drainage; Covello and Staley soils are calcareous at or near the surface; and Naff and Thatuna soils have a silty clay loam subsoil.

Practically all areas of the nearly level to steep soils are farmed. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. An annual cropping system is used. Most areas of very steep soils are small and isolated. They are unfenced and are used for wildlife habitat and range.

5. Palouse-Staley association

Well drained, moderately permeable silt loams are dominant in this association. This association is in the north-central part of the county. The topography consists of irregularly oriented hills and ridges that have narrow tops and are separated by U-shaped draws (fig. 6). Cirquelike amphitheater enclosures are on the northern sides of the hills in places. Side slopes are

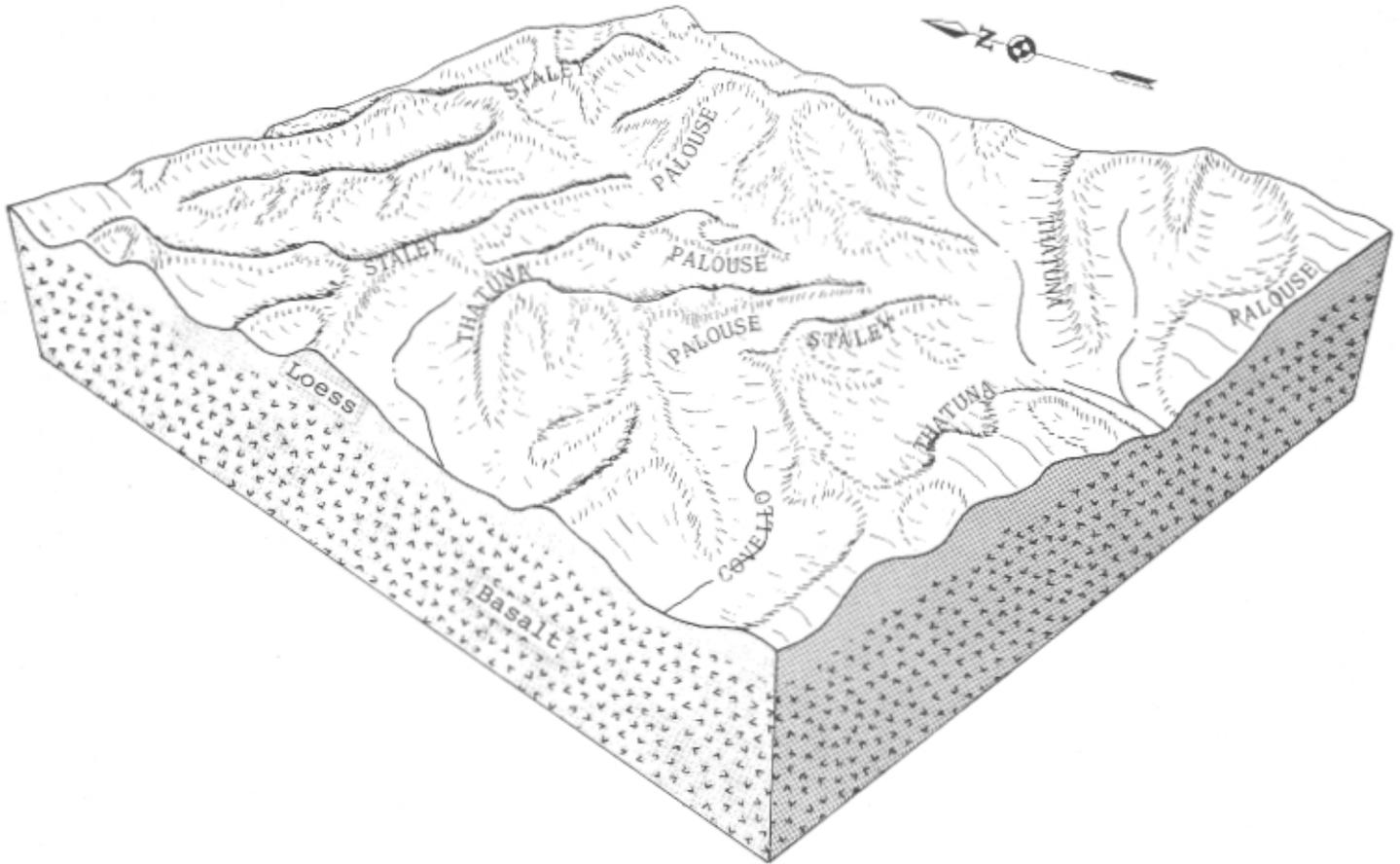


Figure 6.-Typical landscape in the Palouse-Staley association.

strongly sloping to steep. Side slopes facing north and northeast are generally shorter and steeper than those facing south and west. Total relief of individual hills is 25 to 160 feet. The area is intensely dissected, and the drainage pattern is subparallel and dendritic. Annual precipitation is 18 to 21 inches. Elevation ranges from 2,100 to 2,700 feet.

This association makes up approximately 5 percent of the county. Palouse soils make up about 79 percent of the association; Staley soils about 11 percent; Thatuna soils about 8 percent; Covello soils about 1 percent; and small areas of other soils about 1 percent.

Palouse soils are on south-facing side slopes and convex north-facing side slopes. Typically, Palouse soils have a dark grayish brown and grayish brown silt loam surface layer about 24 inches thick and a pale brown silt loam subsoil that extends to a depth of 60 inches.

Staley soils are on narrow ridgetops. They have a grayish brown silt loam surface layer 18 inches thick and a brown, moderately alkaline, calcareous silt loam subsoil and substratum.

Thatuna soils are on north- and northeast-facing, concave and smooth, uniform side slopes. Covello soils are in narrow drainageways and on alluvial fans.

The remaining soils in this association are dominantly deep silt loams. Covello and Thatuna soils have

restricted drainage, and Thatuna soils have a silty clay loam subsoil.

Practically all areas of the nearly level to steep soils are farmed. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. An annual cropping system is used. Most areas of the very steep soils are small and isolated. They are unfenced and are used for wildlife habitat and range.

6. Palouse-Thatuna association

Well drained and moderately well drained, moderately permeable and moderately slowly permeable silt loams are dominant in this association. This association is in the eastern part of the county. The topography consists mainly of long, narrow, irregularly oriented hills or ridges separated by U-shaped draws (fig. 7). Side slopes are strongly sloping to very steep. Side slopes facing north and northeast are generally shorter and steeper than those facing south and west. Old, resistant surfaces are exposed on sides of low-lying knobs, and cirquelike amphitheater enclosures are on the north sides of the hills in places. Total relief of individual hills is 50 to 180 feet. The area is intensely dissected, and the drainage pattern is subparallel. Annual precipitation is 19 to 22 inches. Elevation ranges from 2,200 to 2,900 feet.

This association makes up approximately 13 percent of the county. Palouse soils make up about 62 percent

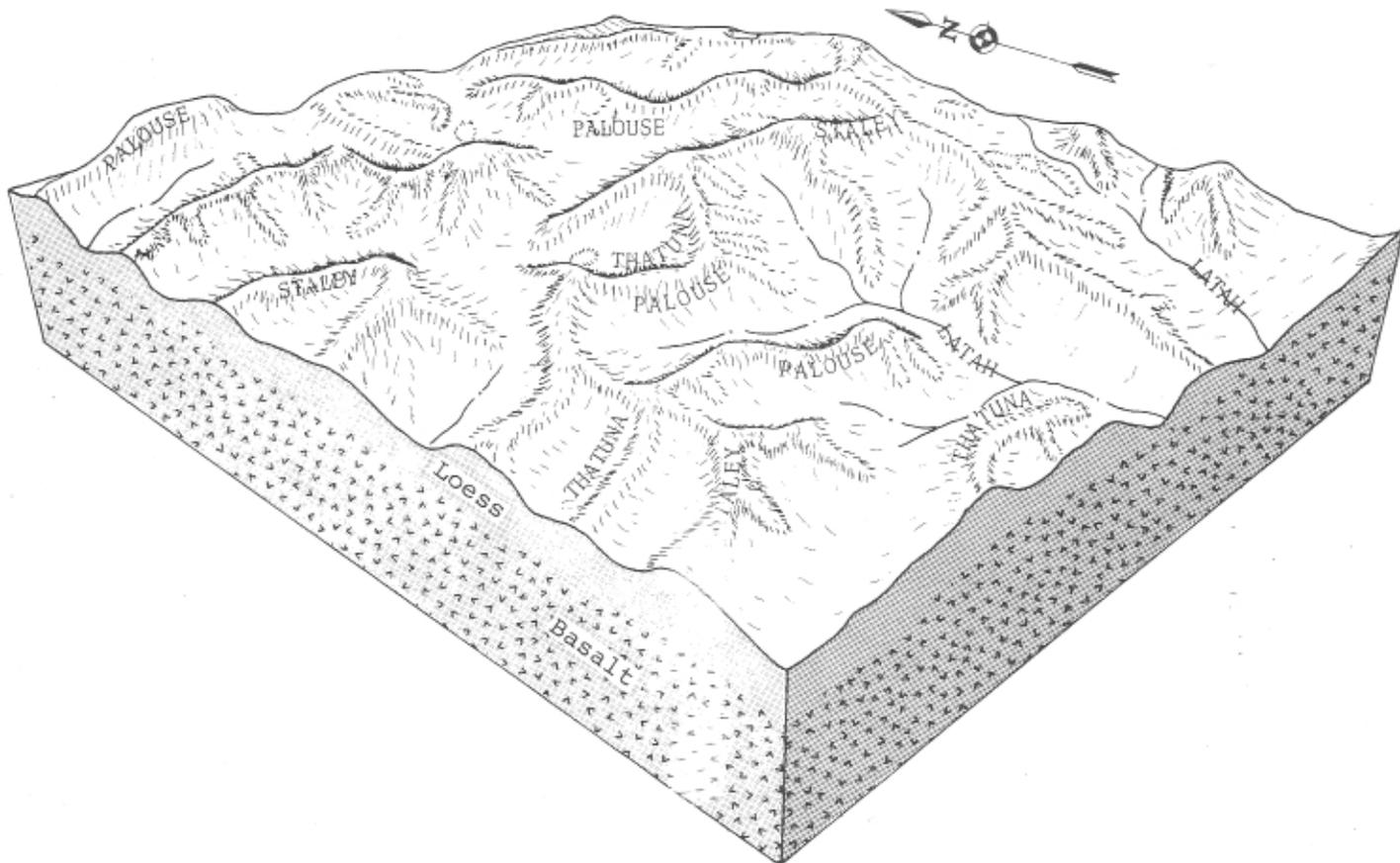


Figure 7.-Typical landscape in the Palouse-Thatuna association.

of the association ; Thatuna soils about 16 percent; Naff soils about 7 percent; Garfield and Staley soils about 8 percent; Latah and Caldwell soils about 5 percent; Tilma soils about 1 percent; and small areas of other soils about 1 percent.

Palouse soils are on south-facing side slopes, convex north-facing side slopes, and very small, oval, rather flat hilltops. Typically, Palouse soils have a dark grayish brown and grayish brown silt loam surface layer about 24 inches thick and a pale brown silt loam subsoil that extends to a depth of 60 inches.

Thatuna soils are on concave and smooth, uniform, north- and northeast-facing side slopes. Typically, Thatuna soils have a dark grayish brown silt loam surface layer about 16 inches thick. The subsoil is brown silt loam to a depth of 33 inches, light brownish gray silt loam to a depth of 39 inches, and pale brown and light yellowish brown silty clay loam to a depth of 60 inches.

The larger areas of Naff soils are on south-facing sides of low-lying hills, and the smaller areas are on low-lying shoulders, knobs, and interconnecting ridges. Garfield soils are on low-lying shoulders, knobs, saddles, and ridges. Staley soils are on higher narrow ridgetops. Tilma soils are on lower parts of north-facing convex side slopes, shoulders, and low-lying knobs. Latah and Caldwell soils are in narrow drainageways and on alluvial fans.

The remaining soils in this association are domi-

nantly deep silt loams; Garfield soils, however, are silty clay loams. Naff soils have a subsoil of silty clay loam, and Tilma soils have a subsoil of silty clay. Staley soils are calcareous throughout, and Caldwell and Latah soils have restricted drainage.

Most of this association is farmed. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. An annual cropping system is used. Some of the steeper areas are used for wildlife habitat and range.

7. Palouse-Thatuna-Naff association

Well drained and moderately well drained, moderately permeable and moderately slowly permeable silt loams are dominant in this association. This association is in the northeastern part of the county. The topography consists mainly of irregularly oriented, sharp-topped ridges and rounded hills interspersed with U-shaped draws (fig. 8). Side slopes are strongly sloping to steep. Side slopes facing north and northeast are generally shorter and steeper than those facing south and west. Old, resistant surfaces are exposed as knobs. In places they are connected to the main hills by spur ridges. Cirquelike amphitheater enclosures are on the north-facing sides of some hills. Total relief of individual hills is 25 to 130 feet. The area is intensively dissected in most places, but in some places along the eastern edge of the association the topography is subdued. Drainage patterns are subparallel and dendritic.

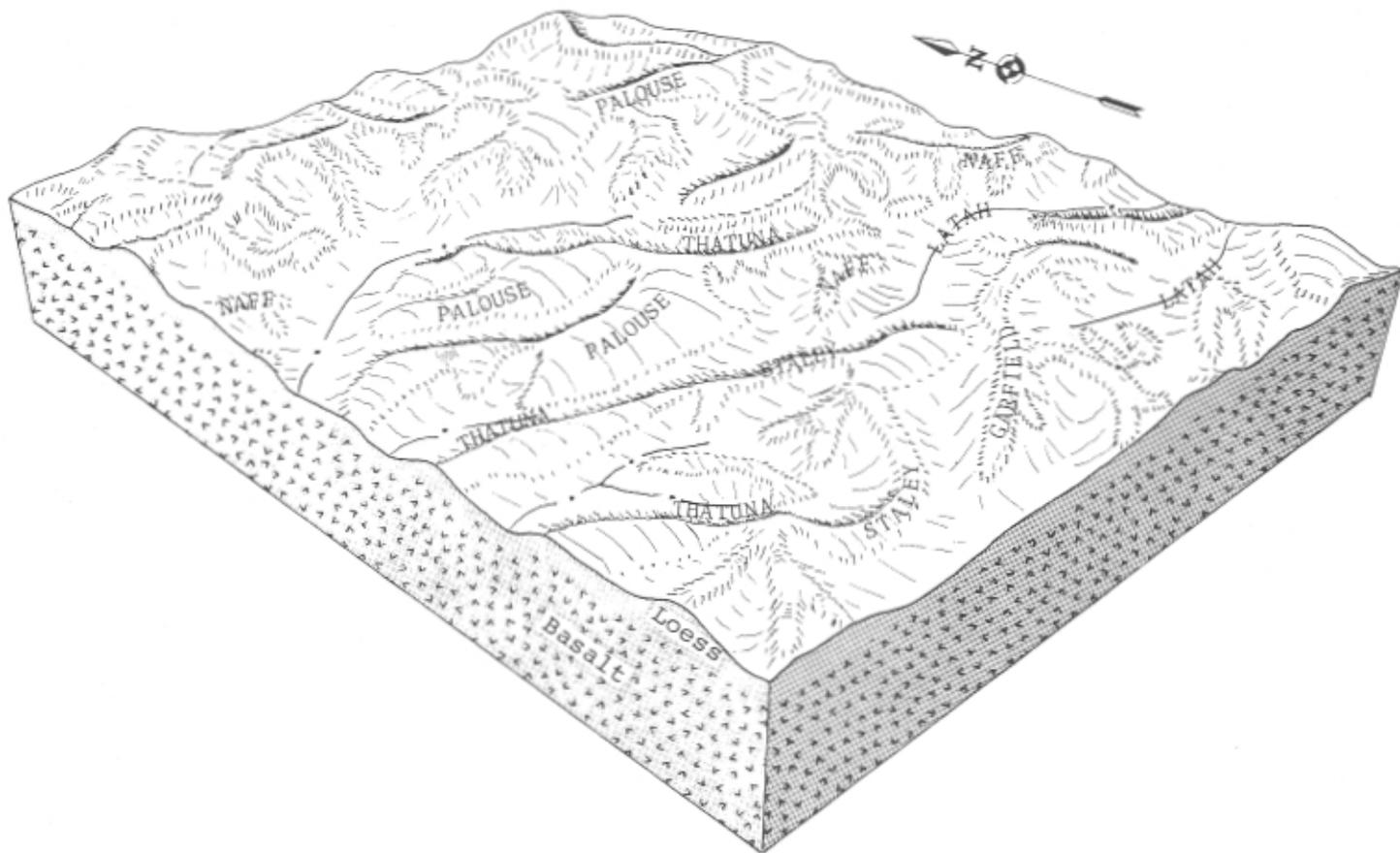


Figure 8.-Typical landscape in the Palouse-Thatuna-Naff association.

Annual precipitation is 21 to 23 inches. Elevation ranges from 2,400 to 2,800 feet.

This association makes up approximately 9 percent of the county. Palouse soils make up about 46 percent of the association; Thatuna soils about 30 percent; Naff soils about 11 percent; Latah and Caldwell soils about 5 percent; Garfield and Staley soils about 5 percent; Tilma soils about 2 percent; and small areas of other soils about 1 percent.

Palouse soils are on broad ridgetops and south-facing side slopes. Typically, Palouse soils have a dark grayish brown and grayish brown silt loam surface layer about 24 inches thick and a pale brown silt loam subsoil that extends to a depth of 60 inches.

Thatuna soils are on smooth and concave, north-facing side slopes and concave foot slopes. Typically, Thatuna soils have a dark grayish brown silt loam surface layer about 16 inches thick. The subsoil is brown silt loam to a depth of 33 inches, light brownish gray silt loam to a depth of 39 inches, and pale brown and light yellowish brown silty clay loam to a depth of 60 inches.

The larger areas of Naff soils are on undulating, south-facing sides of low-lying hills, and the smaller areas are on low-lying shoulders, knobs, and ridges. Typically, Naff soils have a dark grayish brown silt loam surface layer about 9 inches thick. The upper part of the subsoil, to a depth of about 47 inches, is dark brown and yellowish brown silty clay loam. The lower

part is light yellowish brown silt loam that extends to a depth of 60 inches.

Latah and Caldwell soils are in narrow drainageways and on alluvial fans. Garfield soils are on low-lying shoulders, knobs, saddles, and narrow ridgetops. Staley soils are generally on higher narrow ridgetops. Tilma soils are on the lower part of convex side slopes, shoulders, and low-lying knobs.

The other soils in this association are dominantly deep silt loams; Garfield soils, however, are silty clay loams. Caldwell and Latah soils have restricted drainage, Tilma soils have a subsoil of silty clay loam or silty clay, and Staley soils are calcareous below a depth of about 18 inches.

Most of the acreage of this association is farmed. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. An annual cropping system is used. Some of the steeper areas are used for wildlife habitat and range.

Very Deep to Moderately Deep Soils Formed in Loess and in Colluvium and Residuum from Metasediments; on Buttes

These soils are on scattered, prominent buttes. Elevation ranges from 2,500 to 4,000 feet. The average annual precipitation ranges from 21 to 23 inches.

These soils are used for dryland farming, range, woodland, and wildlife habitat.

The one association in this group makes up about 3 percent of the county.

8. Palouse-Thatuna-Tekoa association

Well drained and moderately well drained, moderately permeable and moderately slowly permeable silt loams are dominant in this association. This association is in the eastern part of the county. The topography consists of high, isolated hills that are prominent on the landscape (fig. 9). The upper side slopes are moderately steep to very steep and the foot slopes are strongly sloping to steep. The drainage pattern is radial. Annual precipitation is 21 to 23 inches. Elevation ranges from 2,500 to 4,000 feet.

This association makes up approximately 3 percent of the county. Palouse soils make up about 28 percent of the association; Thatuna soils about 18 percent; Tekoa soils about 15 percent; Schumacher soils about 13 percent; Naff soils about 12 percent; Garfield and Staley soils about 5 percent; Tilma and Larkin soils about 4 percent; Latah, Caldwell, and Konert soils about 4 percent; and small areas of other soils about 1 percent.

Palouse soils are on broad ridgetops and south-

facing side slopes on lower parts of buttes. Typically, Palouse soils have a dark grayish brown and grayish brown silt loam surface layer about 24 inches thick and a pale brown silt loam subsoil that extends to a depth of 60 inches.

Thatuna soils are on upper concave side slopes, low concave foot slopes, and smooth uniform side slopes that extend in a northerly direction. Typically, Thatuna soils have a dark grayish brown silt loam surface layer about 16 inches thick. The subsoil is brown silt loam to a depth of 33 inches, light brownish gray silt loam to a depth of 39 inches, and pale brown and light yellowish brown silty clay loam to a depth of 60 inches.

Tekoa soils are on flat butte tops and flat and concave upper sides of buttes. Typically, Tekoa soils have a dark grayish brown and grayish brown gravelly silt loam surface layer about 7 inches thick; a brown and pale brown gravelly loam subsoil that extends to a depth of 20 inches; and a yellow, very gravelly loam substratum that extends to metasediments at a depth of 38 inches.

Schumacher soils are on gently sloping to steep side slopes and foot slopes on buttes. Naff soils are on tops of narrow ridges and on undulating south-facing side

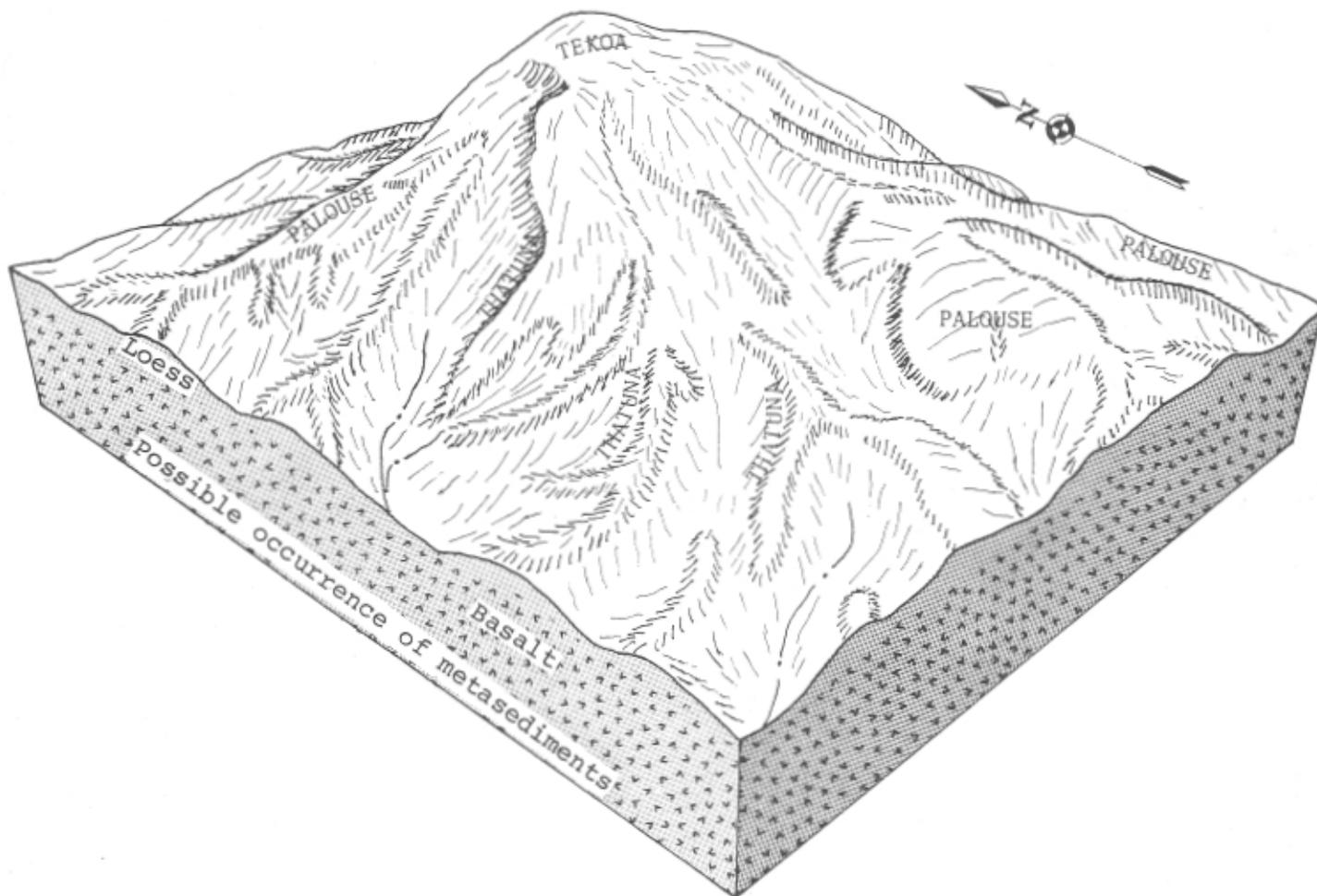


Figure 9.-Typical landscape in the Palouse-Thatuna-Tekoa association.

slopes which extend outward from sides of buttes. Garfield soils are on tops of narrow ridges which extend outward from sides of buttes, low-lying shoulders, knobs, and saddles. Staley soils are on narrow ridges which extend outward from sides of buttes. Tilma soils are on the lower part of convex slopes, shoulders, and low-lying knobs. Larkin soils are on the foot slopes of buttes. Latah, Caldwell, and Konert soils are in narrow drainageways.

Garfield and Konert soils in this association have a surface layer of silty clay loam, and the surface layer of the other remaining soils is dominantly silt loam. Schumacher, Naff, Larkin, Tilma, and Konert soils have a subsoil of silty clay loam or silty clay. Staley soils are calcareous below a depth of about 18 inches, and Caldwell, Konert, and Latah soils have restricted drainage.

Most of the soils on lower south- and west-facing side slopes and a few soils on lower north- and east-facing side slopes are farmed. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. An annual cropping system is used. Most of the very steep soils and soils on upper parts of south- and west-facing side slopes are used for range and for wildlife habitat. Some soils on north- and east-facing, moderately steep to very steep side slopes are used for woodland, woodland grazing, and wildlife habitat.

Very Deep Soils Formed in Loess; in Valleys

These soils are in the major drainageways and are on the sides of the drainageways. Elevation ranges

from 1,400 to 2,700 feet. The average annual precipitation ranges from 14 to 23 inches.

These soils are used for dryland farming, range, woodland, and wildlife habitat.

The one association in this group makes up about 14 percent of the county.

9. Palouse-Athena association

Well drained, moderately permeable silt loams are dominant in this association. The association includes all of the major drainageways in Whitman County, the adjacent bottom lands, and the gently sloping to very steep side slopes that lead down to the drainageways (fig. 10). Annual precipitation is 14 to 23 inches. Elevation ranges from 1,400 to 2,700 feet.

This association makes up approximately 14 percent of the county. Palouse soils make up about 30 percent of the association; Athena soils about 17 percent; Caldwell, Latah, Covello, Pedigo, Narcisse, Mondovi, Hermiston, Onyx, and Konert soils about 21 percent; Thatuna, Walla Walla, Larkin, Chard, Calouse, Snow, Uhlig, and Spofford soils about 18 percent; Gwin, Tucannon, Almota, Kuhl, Alpowa, Linville, Speigle, Bakeoven, and Asotin soils about 13 percent; and small areas of other soils about 1 percent.

Palouse and Athena soils are in large areas with long, south-facing side slopes. Some of these areas are in the northeastern part of the county and lack Athena soils; some are in the western part of the county and lack Palouse soils.

Typically, Palouse soils have a dark grayish brown and grayish brown silt loam surface layer about 24

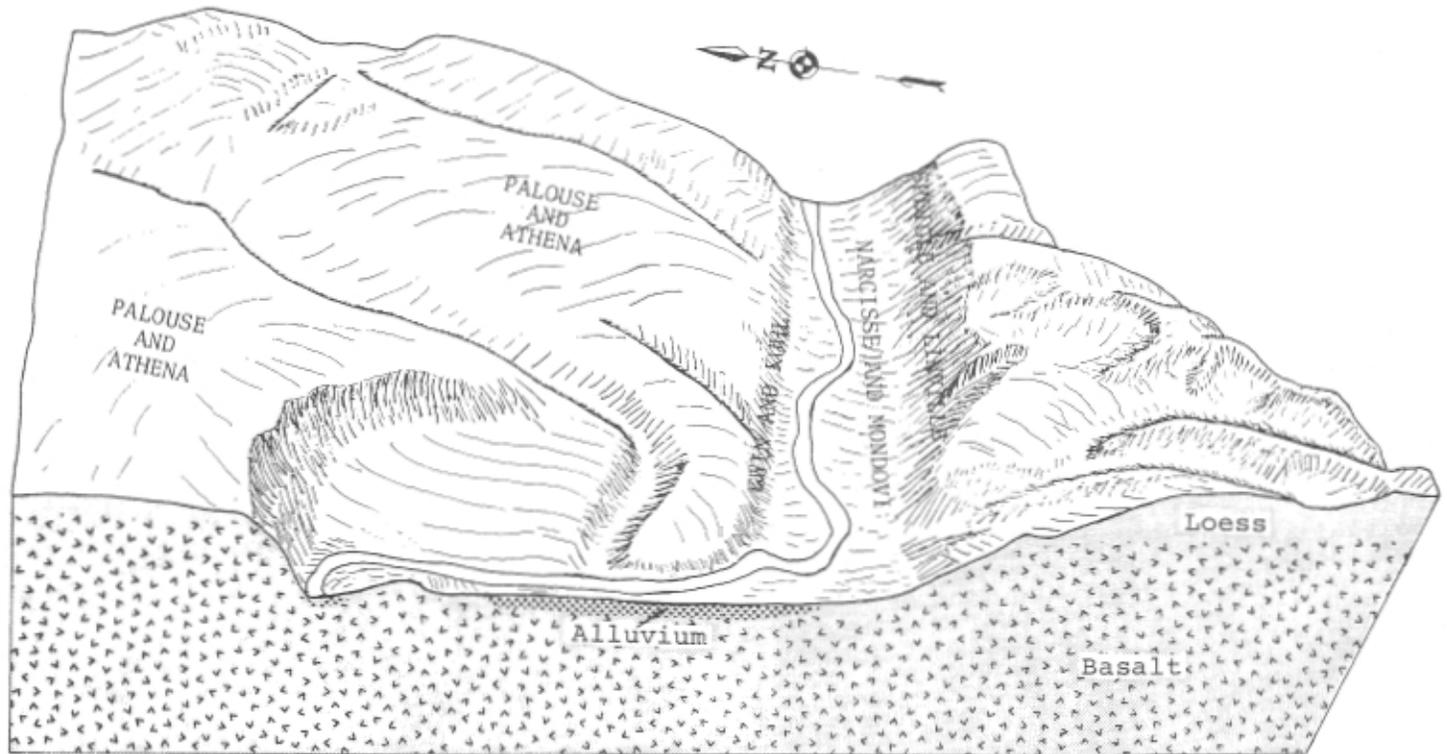


Figure 10.-Topical landscape in the Palouse Athena association.

inches thick and a pale brown silt loam subsoil that extends to a depth of 60 inches.

Typically, Athena soils have a dark grayish brown and grayish brown silt loam surface layer about 20 inches thick, a brown and pale brown silt loam subsoil that extends to a depth of 48 inches, and a light gray, calcareous silt loam substratum.

Caldwell, Latah, Covello, Pedigo, Konert, Narcisse, Modovi, and Onyx soils are in nearly level drainageways and alluvial fans. Hermiston soils are in narrow drainageways and alluvial terraces. Thatuna soils are on north- and northeast-facing side slopes in the eastern part of the county. Larkin soils are mainly on valley sides of the Palouse River in the eastern part. Chard and Uhlig soils are on outwash terraces in the northwestern part of the county. Calouse and Walla Walla soils are on south-facing side slopes. Calouse soils are in the central part of the county, and Walla Walla soils are in the western part. Snow soils are on terraces and foot slopes in the eastern part of the county. Spofford soils occur as circular spots mainly on broad, south-facing side slopes in the central part of the county. Gwin, Kuhl, and Bakeoven soils are on strongly sloping to very steep south-facing side slopes. Tucannon, Almota, and Asotin soils are also mainly on south-facing side slopes. Alpowa, Linville, and Speigle soils are on colluvial foot slopes and steep and very steep, north-facing colluvial slopes.

Of the remaining soils, Caldwell, Latah, Covello, Pedigo-Konert, and Thatuna soils have restricted drainage; Gwin, Kuhl, and Bakeoven soils have bedrock near the surface and are cobbly or very cobbly; and Larkin soils have a silty clay loam or silty clay subsoil.

Most of the soils on very steep side slopes in the western and southern parts of the county and on south- and west-facing side slopes in the eastern part of the county are used for range and for wildlife habitat. Many soils on east- and north-facing side slopes in the eastern part of the county are used for woodland and woodland grazing. The soils on nearly level bottom land and gently sloping to steep side slopes are mainly farmed. Wheat, barley, legumes, and grass are the principal crops.

Very Shallow to Moderately Deep Soils Formed in Loess and Glacial Outwash; in Channeled Scablands

This group occupies the basaltic plateaus. Elevation ranges from 540 to 2,300 feet. The average annual precipitation ranges from 11 to 18 inches.

This group is used mainly for range and wildlife habitat.

The two associations in this group make up about 12 percent of the county.

10. Anders-Benge-Kuhl association.

Well drained, moderately permeable silt loams and cobbly silt loams that are underlain by basalt bedrock or gravel are dominant in this association. This association is in the western part of the county. The landscape consists of a gently sloping to strongly slop-

ing, scarred basaltic plateau. The plateau has a few moderately steep to very steep basalt cliffs, ledges, loess islands and a few rock colluvial slopes on the sides of buttes, mesas, and canyons (fig. 11). There are also many undrained basins and gently sloping and strongly sloping outwash terraces that have moderately steep and steep side slopes. Much of the area has patterned ground, which is the general term applied to mounds, stone nets, and stone strips. Annual precipitation is 11 to 15 inches. Elevation ranges from 540 to 2,050 feet.

This association makes up approximately 9 percent of the county. Anders soils make up about 25 percent of the association; Benge soils about 16 percent; Kuhl soils about 16 percent; Bakeoven soils about 12 percent; Rock outcrop about 6 percent; Emdent soils about 3 percent; Roloff, Beckley, Starbuck, Alpowa, Stratford, and Magallon soils about 10 percent; Walla Walla, Chard, and Endicott soils about 6 percent; Hermiston, Onyx, and Pedigo soils about 3 percent; and small areas of other soils about 3 percent.

Anders soils are on mounds and are in intricate patterns on the landscape with Kuhl soils. Typically, Anders soils have a dark grayish brown and grayish brown silt loam surface layer about 11 inches thick and a dark brown and brown silt loam subsoil that extends to basalt bedrock at a depth of 33 inches.

Benge soils are on outwash terraces. Typically, Benge soils have a dark grayish brown and grayish brown silt loam surface layer about 16 inches thick and a brown silt loam subsoil that extends to a depth of 24 inches. The substratum to a depth of 30 inches is brown, very gravelly silt loam. Below this, it is very gravelly and cobbly loamy sand.

Kuhl soils are in areas between mounds. Typically, Kuhl soils have a dark grayish brown and grayish brown cobbly and gravelly silt loam surface layer about 10 inches thick and a yellowish brown gravelly silt loam subsoil that extends to basalt bedrock at a depth of 16 inches.

Alpowa soils are on colluvial side slopes. Roloff and Starbuck soils are in the southwestern part of the association and have patterned ground. Roloff soils are on mounds. Bakeoven and Starbuck soils and Rock outcrop are in areas between the mounds. Emdent soils are mainly in undrained basins, but they are in some nearly level drainageways. Beckley and Chard soils are on outwash terraces. Stratford and Magallon soils are on outwash terraces in the southwestern part of the association. Walla Walla soils are on streamlined loess islands within the channeled scablands. Endicott soils are on low-lying broad benches along edges of channeled scabland and on ridgetops and margins of loess islands. Nearly level Hermiston, Onyx, and Pedigo soils are in drainageways.

Of the remaining soils in this association, Bakeoven and Starbuck soils are cobbly or very cobbly and are underlain by bedrock that is near the surface; Beckley, Stratford, and Magallon soils have coarse sand at a depth of 20 to 40 inches; Endicott and Boloff soils have a hardpan or basalt at a depth of 20 to 40 inches; and Emdent and Pedigo soils have restricted drainage.

Most areas of this association are used for range or for wildlife habitat.

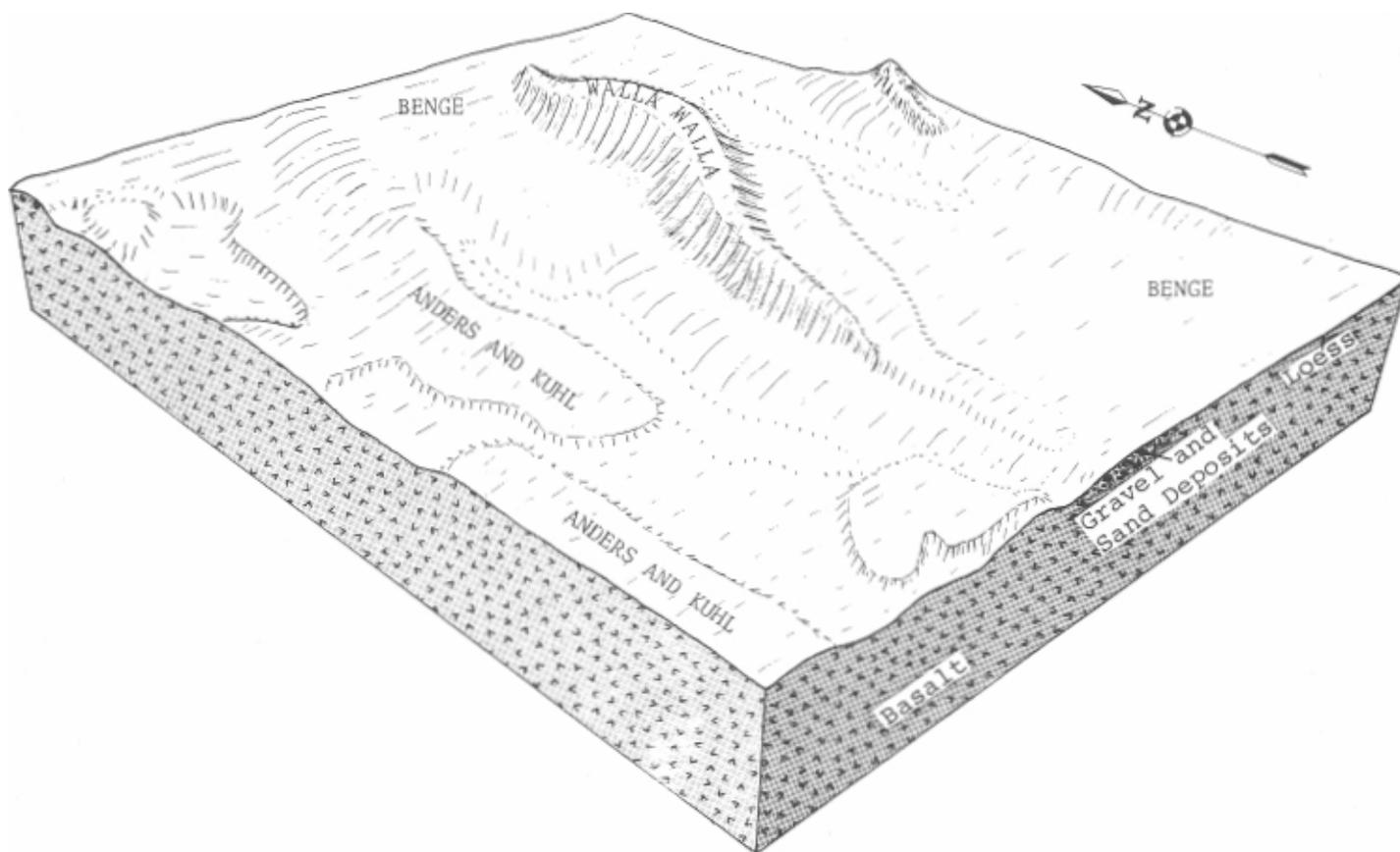


Figure 11.- Typical landscape in the Anders-Benge-Kuhl association.

11. Bakeoven-Tucannon-Cheney association

Well drained, moderately permeable and moderately slowly permeable, very cobbly loams and silt loams that are underlain by basalt bedrock or gravel are dominant in this association. This association is in the northern part of the county. The landscape consists of a gently sloping to strongly sloping, scarred basaltic plateau. This plateau has moderately steep to very steep cliffs, ledges, loess islands, and rocky colluvial slopes on side slopes of buttes, mesas, and canyons (fig. 12). There are also many undrained basins and gently sloping and strongly sloping outwash terraces which may have moderately steep and steep sides. Much of the area has patterned ground. The annual precipitation is 15 to 18 inches. Elevation ranges from 1,600 to 2,300 feet.

This association makes up approximately 3 percent of the county. Bakeoven soils make up about 24 percent of the association; Tucannon soils about 22 percent; Cheney soils about 15 percent; Gwin soils about 12 percent; Rock outcrop about 8 percent; Covello, Pedigo, Emdent, Mondovi, and Hermiston soils about 12 percent; Hesseltine, Speigle, and Uhlig soils about 6 percent; and small areas of other soils about 1 percent.

Tucannon and Bakeoven soils occur mainly in intricate patterns on the landscape with Gwin soils and Rock outcrop in areas of patterned ground. Typically,

Bakeoven soils have a grayish brown, very cobbly loam surface layer about 5 inches thick and a brown, very gravelly loam subsoil over basalt bedrock at a depth of 8 inches.

Tucannon soils are on mounds. Typically, Tucannon soils have a dark grayish brown silt loam surface layer about 13 inches thick. The upper part of the subsoil, to a depth of 26 inches, is brown and pale brown silt loam. The lower part is pale brown gravelly silt loam that extends to basalt bedrock at a depth of 30 inches.

Cheney soils are on outwash terraces. Typically, Cheney soils have a dark grayish brown silt loam surface layer about 16 inches thick and a brown gravelly loam subsoil that extends to a depth of 29 inches. The substratum, to a depth of 36 inches, is brown very gravelly loam. Below this, it is gravel, cobbles, and sand.

Bakeoven and Gwin soils and Rock outcrop are in areas between the mounds. Uhlig soils are on outwash terraces. Covello, Pedigo, and Emdent soils are on nearly level bottom lands and undrained basins. Mondovi and Hermiston soils are on nearly level bottom lands. Hesseltine soils are on outwash terraces in the northern part of this association. Steep and very steep Speigle soils are mainly on north-facing colluvial side slopes.

Of the remaining soils in this association, Mondovi,

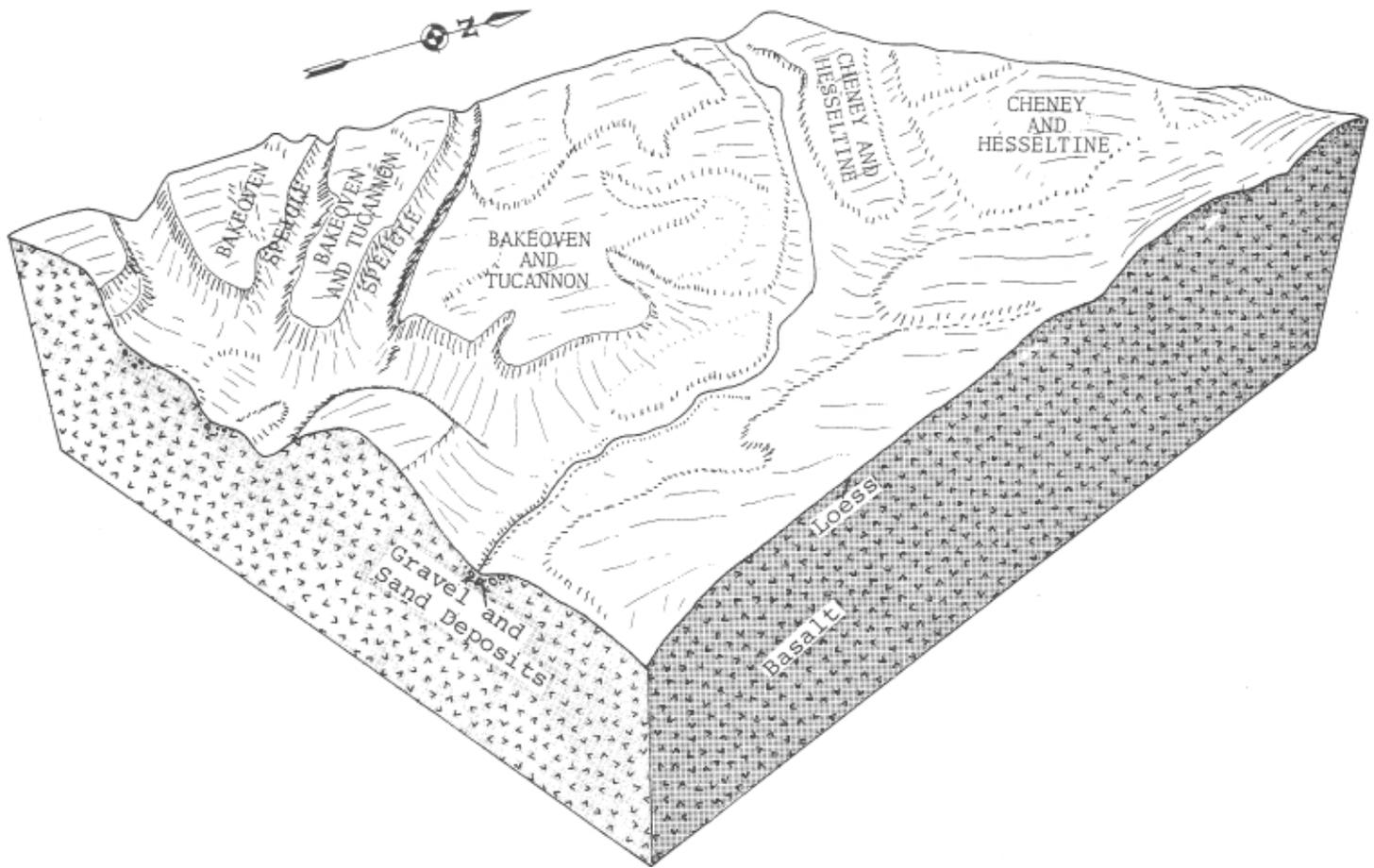


Figure 12. - Typical landscape in the Bakeoven-Tucannon-Cheney association.

Hermiston, and Uhlig soils are very deep, well drained silt loams; Speigle soils are cobbly or very stony; Hesselstine soils are underlain by sand, gravel, and cobbles at a depth of 20 to 40 inches; Gwin soils are underlain by basalt bedrock at a depth of 10 to 20 inches; and Covello, Pedigo, and Emdent soils have restricted drainage.

Most of this association is used for range and for wildlife habitat.

Shallow to Very Deep Soils Formed in Residuum from Basalt; in Canyons

This group occupies breaks of the Snake River. Elevations range from 540 to 2,800 feet. The average annual precipitation ranges from 11 to 18 inches.

This group is used mainly for range and wildlife habitat.

The two associations in this group make up about 7 percent of the county.

12. Kuhl-Alpowa association

Well drained, moderately permeable, cobbly silt loams are dominant in this association. This association is in the southern part of the county along the

Snake River. The landscape consists of steep and very steep canyon sides and gently sloping to moderately steep terraces (fig. 13). Annual precipitation is 12 to 18 inches. Elevation ranges from 640 to 2,800 feet.

This association makes up approximately 5 percent of the county. Kuhl soils make up about 30 percent of the association; Alpowa soils about 18 percent; Bakeoven, Asotin, Walla Walla, Linville, Gwin, Athena, and Almota soils and Rock outcrop about 43 percent; Chard and Farrell soils about 4 percent; and small areas of other soils about 5 percent.

Kuhl soils occur in intricate patterns on the landscape with Alpowa and Asotin soils, Bakeoven and Chard soils, and Rock outcrop. Typically, Kuhl soils have a dark grayish brown and grayish brown cobbly and gravelly silt loam surface layer about 10 inches thick and a yellowish brown gravelly silt loam subsoil that extends to basalt bedrock at a depth of 16 inches.

Alpowa soils are on colluvial foot slopes and steep and very steep, north-facing colluvial side slopes. Typically, Alpowa soils have a dark grayish brown cobbly silt loam surface layer about 8 inches thick. The underlying material is brown gravelly silt loam to a depth of 15 inches and brown, pale brown, and white gravelly loam to a depth of 44 inches. Fractured basalt is at a depth of 44 inches. The soil is calcareous and moderately alkaline at a depth of less than 20 inches.

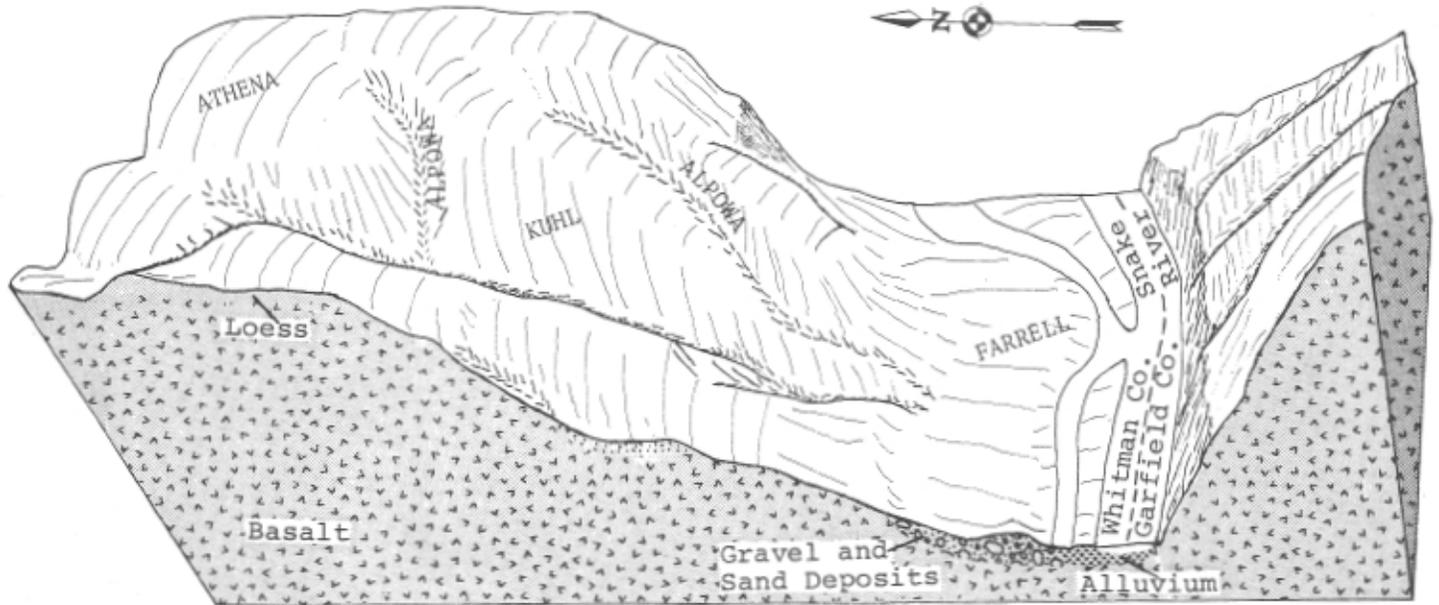


Figure 13.-Tropical landscape in the Kuhl-Alpowa association.

Large areas of Asotin soils are on long ridges with broad tops. Walla Walla soils are on long, broad ridgetops and join Athena soils on the upper edge and Asotin soils on the lower edge. Linville soils are on steep and very steep, north-facing colluvial side slopes at higher elevations than Alpowa soils. Gwin and Linville soils occur in an intricate pattern on very steep, north-facing side slopes at higher elevations than Kuhl soils. Narrow areas of Almota soils join Athena soils on the upper edge and Kuhl soils on the lower edge of south-facing side slopes. Chard soils are on outwash terraces at elevations of less than 1,200 feet. Farrell soils are on outwash terraces below Chard soils.

Of the remaining soils in this association, Walla Walla, Athena, Chard, and Linville soils are very deep, well drained silt loams; Gwin, Bakeoven, Asotin, and Almota soils are underlain by basalt near the surface or at a depth of 20 to 40 inches; and Farrell soils are underlain by coarse sand.

Most areas of this association are used for range and wildlife habitat.

13. Starbuck-Alpowa association

Well drained, moderately permeable, cobbly silt loams are dominant in this association. This association is in the southwestern part of the county along the Snake River. The landscape consists of steep and very steep canyon sides and gently sloping to moderately steep terraces (fig. 14). Annual precipitation is 11 to 12 inches. Elevation ranges from 540 to 1,600 feet.

This association makes up approximately 2 percent of the county. Starbuck soils make up about 27 percent of the association; Alpowa soils about 23 percent; Roloff, Ritzville, Bakeoven, Walla Walla, and Kuhl soils and Rock outcrop about 35 percent; Farrell, Magallon, and Stratford soils about 12 percent; and small areas of other soils about 3 percent.

Starbuck and Alpowa soils occur in intricate patterns on the landscape with Roloff, Bakeoven, Magallon, and Stratford soils and Rock outcrop.

Starbuck soils are on steep and very steep canyon sides. Typically, Starbuck soils have a grayish brown cobbly silt loam and brown gravelly silt loam surface layer about 9 inches thick and a pale brown gravelly loam subsoil that extends to basalt bedrock at a depth of 15 inches.

Alpowa soils are on steep colluvial foot slopes and very steep, north-facing colluvial side slopes. Typically, Alpowa soils have a dark grayish brown cobbly silt loam surface layer about 8 inches thick. The underlying material to a depth of 15 inches is brown gravelly silt loam. Below this it is brown, pale brown, and white gravelly loam that extends to a depth of 44 inches. Fractured basalt is at a depth of 44 inches. The soil is calcareous and moderately alkaline at a depth of more than 20 inches.

Larger areas of Roloff soils are on long, broad ridgetops. Ritzville soils are mainly on long, broad ridgetops. Ritzville and Walla Walla soils are also on some of the steep and very steep north-facing side slopes. Kuhl soils are in an intricate pattern with Alpowa soils on some of the very steep, north-facing side slopes at higher elevations. Bakeoven soils are on upper side slopes adjacent to Rock outcrop. Farrell, Magallon, and Stratford soils are on outwash terraces at elevations of less than 1,200 feet.

Of the remaining soils in this association, Ritzville and Walla Walla soils are very deep, well drained silt loams; Bakeoven and Kuhl soils are underlain by basalt near the surface; Roloff soils have basalt at a depth of 20 to 40 inches; and Stratford, Magallon, and Farrell soils are underlain by coarse sand or very gravelly coarse sand.

Most areas of this association are used for range or for wildlife habitat.

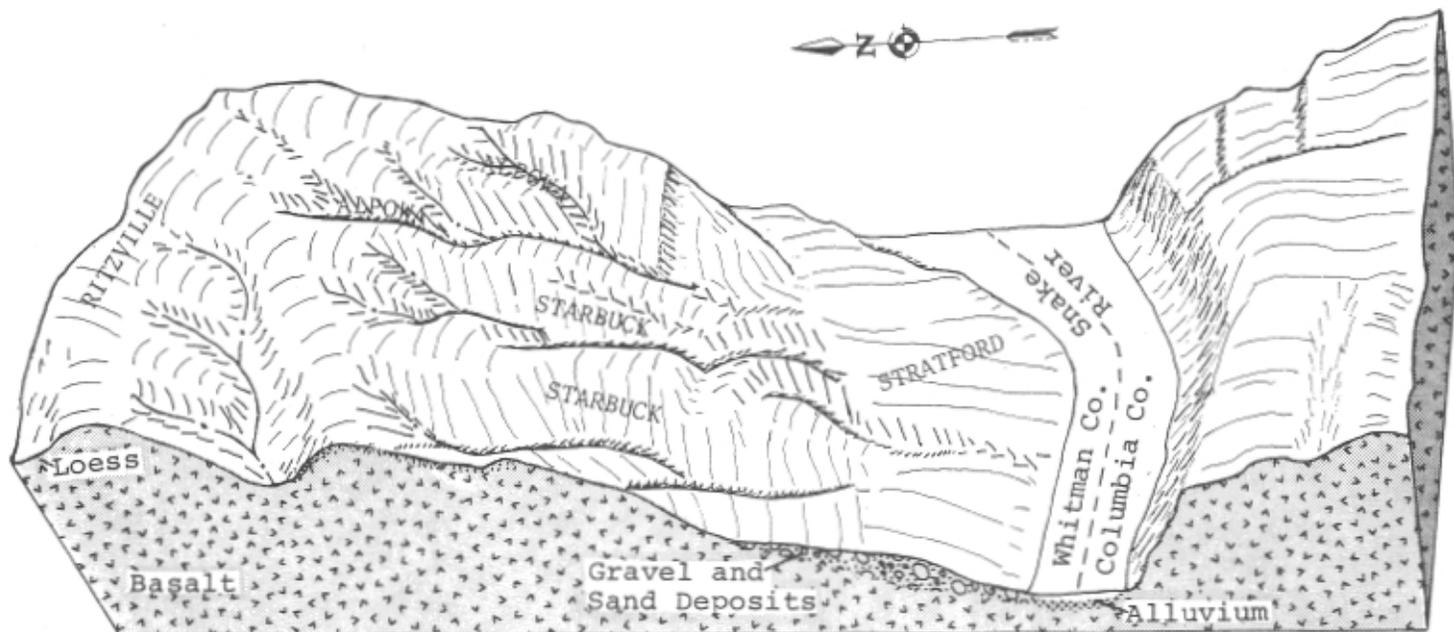


Figure 14.-Typical landscape in the Starbuck-Alpowa association.

Descriptions of the Soils

The soil series and mapping units in Whitman County are described in this section. Each soil series is described in detail, and then, briefly, each mapping unit in that series is described. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the descriptions of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for dry soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Riverwash and Rock outcrop, for example, do not belong to a soil series, but nevertheless, are listed in alphabetic order with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description is the capability unit and range site in which the mapping unit has been placed. Not all units are assigned to a range site. The page where each soil is described

can be found by referring to the "Index to Mapping Units" at the front of the survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (6).

Almota Series

The Almota series consists of well drained, strongly sloping to very steep soils underlain by basalt at a depth of 20 to 40 inches. The soils formed in loess that contained some volcanic ash in the upper part and material from underlying basalt in the subsoil. They are on uplands along drainageways in the central and southeastern parts of the county. The elevation is 1,500 to 2,600 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 140 days.

In a representative profile the surface layer is about 9 inches thick. It is dark grayish brown silt loam that is 3 percent basalt gravel. The subsoil, to a depth of 29 inches, is brown and pale brown silt loam that is 3 to 15 percent basalt gravel. The substratum, to a depth of 35 inches, is white calcareous gravelly silt loam that is about 40 percent basalt gravel. Basalt is at a depth of 35 inches.

Almota soils have moderate permeability. The available water capacity is moderate or moderately high. Roots penetrate to bedrock. Almota soils are used mainly for wheat, barley, alfalfa, grass, range, and wildlife habitat.

Representative profile of Almota silt loam, 7 to 25 percent slopes, in a cultivated field, 200 feet east and

In the original manuscript, there was a table in this space.
All tables have been updated and are available as a separate document.

2,300 feet north of the southwest corner of sec. 26, T. 16
N., R. 41 E.:

Ap1-0 to 3 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots and few medium roots; many fine and very fine pores; neutral; abrupt smooth boundary.

Ap2-3 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots and few medium roots; many fine and very fine pores; neutral; abrupt smooth boundary.

B21-9 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thin and me-

dium platy structure parting to weak medium prismatic; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine and medium pores; 3 percent basalt fragments; mildly alkaline; clear wavy boundary.

B22-11 to 19 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine and medium pores; 3 percent small basalt fragments; mildly alkaline; clear wavy boundary.

B23-19 to 29 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate coarse and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and medium pores;

15 percent basalt fragments; moderately alkaline; clear irregular boundary.
Cca-29 to 35 inches; white (10YR 8/2) gravelly silt loam, light brownish gray (10YR 6/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few medium and fine roots; common fine and medium pores partially filled with lime; 40 percent basalt fragments; slightly effervescent; moderately alkaline; abrupt irregular boundary.
IIR-35 inches; fractured basalt; lime in some fractures.

Depth to bedrock is 20 to 40 inches. The control section between a depth of 10 inches and bedrock is 18 to 25 percent clay.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It has weak granular blocky, or platy structure and is neutral or mildly alkaline. The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist and it has chroma of 2 or 3 when moist or dry. It has weak blocky or prismatic structure. The Cca horizon has value of 6 to 8 when dry and 4 to 7 when moist, and it has chroma of 1 to 3 when dry or moist. It is moderately alkaline to strongly alkaline.

1-Almota silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands along sides of drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that are less than 20 inches or more than 40 inches deep to bedrock. Also included are a few areas of Rock outcrop and circular areas called slick spots.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, alfalfa, grass, and range. Capability unit IVE-14 ; Loamy range site (L-3).

2-Almota silt loam, 25 to 65 percent slopes. This moderately steep to very steep soil is on south-facing sides of drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is thinner and there is a higher percentage of gravel in the surface layer and subsoil.

Included with this soil in mapping are areas of soils that are less than 20 inches or more than 40 inches deep to bedrock and a few areas of Rock outcrop.

Runoff is rapid or very rapid, and the hazard of erosion is high to very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; North exposure range site (N-2).

Alpowa Series

The Alpowa series consists of deep, well drained, steep to very steep, cobbly soils that formed in a mixture of loess, material weathered from basalt, and small amounts of volcanic ash. The soils are on south-facing colluvial sides of drainageways along the Snake and Palouse Rivers. The elevation is 600 to 2,500 feet. The native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and rabbitbrush. The annual precipitation is 12 to 16 inches. The frost-free season is 135 to 155 days.

In a representative profile the surface layer is dark grayish brown cobbly silt loam about 8 inches thick. The underlying material is brown and pale brown gravelly- silt loam or loam to a depth of 27 inches and white calcareous gravelly loam to a depth of 44 inches. Basalt is at a depth of 44 inches.

Alpowa soils have moderate permeability. The available water capacity is moderately high or high. Roots penetrate to a depth of 40 to 60 inches or more. Alpowa soils are used mainly for range and for wildlife habitat.

Representative profile of Alpowa cobbly silt loam, 30 to 65 percent slopes, in an area of grassland, 3,500 feet south and 200 feet east of the northwest corner of sec. 18, T. 11 N., R. 56 E.

A1-0 to 8 inches ; dark grayish brown (10YR 4/2) cobbly silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine pores; 25 percent gravel and cobbles of basalt; neutral ; clear wavy boundary.

C1-8 to 15 inches; brown (10YR 5/3) gravelly silt loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots ; many very fine pores; 35 percent gravel and cobbles; mildly alkaline ; clear wavy boundary.

C2-15 to 20 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine pores; 35 percent gravel and cobbles; mildly alkaline.

C3-20 to 27 inches; pale brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky- and slightly plastic; many fine roots ; many very fine pores; 50 percent gravel and cobbles; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C4ca-27 to 44 inches; white (10YR 8/1) gravelly loam, very pale brown (10YR 7/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; 35 percent gravel and cobbles; violently effervescent; moderately alkaline.

R-44 to 60 inches; fractured basalt; lime, silica, and fines in some fracture plains.

Depth to bedrock is 40 to more than 60 inches. The profile is neutral to strongly alkaline and becomes more alkaline as depth increases. The control section between depths of 10 and 40 inches is less than 18 percent clay and between 35 and 50 percent coarse fragments. Depth to carbonates is 1.8 to 30 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is 20 to 40 percent gravel, cobbles, or stones. The C1, C2, and C3 horizons have value of 4 or 5 when dry and 3 or 4 when moist. They are 25 to 45 percent gravel, cobbles, or stones. The C4ca horizon has

value of 6 to 8 when dry and 4 to 7 when moist, and it has chroma of 1 to 3 when dry or moist. It is silt loam or loam and is 35 to 50 percent gravel, cobbles, or stones.

3-Alpowa cobbly silt loam, 30 to 65 percent slopes. This steep to very steep soil is on sides of drainageways.

Included with this soil in mapping are areas of Rock outcrop, soils that are less than 40 inches deep to basalt, and small areas of soils that are more than 60 inches deep to basalt and do not have gravel, cobbles, or stones.

Runoff is rapid or very rapid, and the hazard of erosion is high or very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIIe-1; North exposure range site (N-1).

Anders Series

The Anders series consists of gently sloping to strongly sloping, well drained soils underlain by basalt at a depth of 20 to 40 inches. The soils formed in glacial outwash that contained a mixture of loess and volcanic ash in the upper part. They are in the channeled scablands in the southwestern part of Whitman County. The elevation ranges from 1,000 to 1,800 feet. The native vegetation is bluebunch wheatgrass and Idaho fescue. The annual precipitation is about 12 to 16 inches. The frost-free season is about 135 to 150 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 11 inches thick. The subsoil, to a depth of 32 inches, is dark brown and brown silt loam that is 10 percent gravel and cobbles of basalt. Basalt is at a depth of 32 inches.

Anders soils have moderate permeability. The available water capacity is moderate to moderately high. Roots penetrate to bedrock. Anders soils are used mainly for range, wheat, barley, alfalfa, grass, and wildlife habitat.

Representative profile of Anders silt loam, 3 to 15 percent slopes, in an area of grassland, 1,800 feet east and 40 feet north of the southwest corner of sec. 2, T. 16 N., R. 39 E.:

A11-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium platy structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many roots; 5 percent fine gravel and cobbles of basalt; mildly alkaline; abrupt smooth boundary.

A12-7 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many roots; common fine pores; 5 percent fine gravel or cobbles of basalt; mildly alkaline; abrupt wavy boundary.

B21-11 to 16 inches; dark brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist;

weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine pores; 10 percent angular gravel and cobbles of basalt; mildly alkaline; gradual smooth boundary.

B22-16 to 25 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine pores; 10 percent subangular gravel and cobbles of basalt; mildly alkaline; gradual smooth boundary.

B23-25 to 32 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; common roots; many fine pores; 10 percent subangular gravel and cobbles of basalt; mildly alkaline; abrupt smooth boundary.

IIR-32 inches; basalt.

Depth to bedrock is 20 to 40 inches. The profile is neutral or mildly alkaline throughout. The control section, between a depth of 10 inches and bedrock, is dominantly silt loam. It averages 16 to 18 percent clay, and it is modified by as much as 50 percent basalt gravel and cobbles in the subhorizon immediately above bedrock; however, the weighted average content of coarse fragments in the control section is 3 to 25 percent.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is as much as 15 percent basalt gravel. 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 or gravelly silt loam. In places the IIR layer contains secondary lime in fractures of the bedrock.

4-Anders silt loam, 3 to 15 percent slopes. This gently sloping to strongly sloping soil is in areas of channeled scablands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that are less than 10 inches deep to basalt, soils that are more than 40 inches deep to basalt, and soils that are 20 to 40 inches deep over gravel. Also included are wet basins and Rock outcrop.

Runoff is slow or medium, and the hazard of erosion is slight or moderate.

This soil is used mainly for range, wildlife habitat, wheat, barley, alfalfa, and grass. Capability unit IIIe-6; Loamy range site (L-2).

5-Anders-Kuhl complex, 3 to 15 percent slopes. These gently sloping to strongly sloping soils are in areas of channeled scablands. This complex consists of 40 percent Anders silt loam, 3 to 15 percent slopes, and 30 percent Kuhl cobbly silt loam that has slopes of 3 to 15 percent. The topography is characterized by numerous mounds. The mounds range from 10 to 30 feet in diameter and are generally 1 to 4 feet high and 5 to 20 feet apart. The Anders soil occupies the mounds, and the Kuhl soil occupies the area between the mounds. The Anders soil has a profile similar to the one described as representative of the Anders series, but the

surface layer is 2 to 3 inches thinner. The Kuhl soil in this complex has a profile similar to the one described as representative of the Kuhl series.

Included with these soils in mapping are a few small areas of noncobbly soils, stony soils, soils that are more than 40 inches deep over basalt, soils that are less than 10 inches deep over basalt, wet basins, and Rock outcrop. Included areas make up 30 percent of the mapped acreage of this complex.

Runoff is slow or medium, and the hazard of erosion is slight or moderate.

This complex is used mainly for range and wildlife habitat. Capability unit VIIIs-1; Anders part in Loamy range site (L-2), Kuhl part in Shallow range site (S-2).

Asotin Series

The Asotin series consists of strongly sloping to very steep, well drained soils underlain by basalt at a depth of 20 to 40 inches. The soils formed in a thin layer of loess mixed with some volcanic ash and residuum weathered from the underlying basalt. They are on uplands in the southwestern part of the county. The steep soils border sides of drainageways. Elevation is 1,200 to 2,500 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 135 to 160 days.

In a representative profile the surface layer is about 10 inches thick. It is dark grayish brown and grayish brown silt loam that is 2 percent basalt gravel. The subsoil, to a depth of 25 inches, is brown silt loam that is 3 percent basalt gravel. The substratum, to a depth of 30 inches, is light gray calcareous gravelly silt loam. Basalt is at a depth of 30 inches.

Asotin soils have moderate permeability. The available water capacity is moderate or moderately high. Roots penetrate to bedrock. Asotin soils are used mainly for wheat, barley, grass, alfalfa, range, and wildlife habitat.

Representative profile of Asotin silt loam, 7 to 25 percent slopes, in a cultivated field, 1,700 feet west and 1,400 feet north of the southeast corner of sec. 23, T. 14 N., R. 39 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; 2 percent basalt fragments; neutral; clear wavy boundary.

A12-7 to 10 inches; grayish brown (10YR-5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; 3 percent basalt fragments; neutral; clear wavy boundary.

B21-10 to 17 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; many fine and very fine roots; many fine and very fine pores; 3 percent basalt fragments; neutral; clear wavy boundary.

B22-17 to 25 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; many fine and very fine roots; many fine and very fine pores; 3 percent basalt fragments; mildly alkaline; gradual wavy boundary.

Cca-25 to 30 inches; light gray (10YR 7/2) gravelly silt loam, light brownish gray (10YR 6/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and fine pores; 15 percent basalt fragments; strongly effervescent; moderately alkaline; clear wavy boundary.

IIR 30 inches; basalt, lime and few roots in cracks.

Depth to bedrock is 20 to 40 inches. The control section, between a depth of 10 inches and bedrock, is 5 to 35 percent coarse basalt fragments. It is less than 18 percent clay.

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 to mildly alkaline. The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when moist or dry. It is neutral to moderately alkaline. The Cca horizon has value of 6 to 8 when dry and 5 to 7 when moist, and it has chroma of 2 or 3 when dry or moist. It is moderately alkaline to strongly alkaline.

6-Asotin silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands near south-facing sides of drainageways. It has the profile described as representative of the series. Included with this soil in mapping are soils that range from less than 10 inches to more than 60 inches deep to bedrock and soils that have slopes of less than 7 percent. Also included are circular areas called slick spots.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, alfalfa, grass, and range. Capability unit IVE-13; Loamy range site (L-2).

7-Asotin silt loam, 25 to 65 percent slopes. This moderately steep to very steep soil is on sides of drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is 3 to 4 inches thicker and there is a higher percentage of gravel in the surface layer and subsoil.

Included with this soil in mapping are areas of soils that are less than 10 inches deep to bedrock, areas of soils that are more than 40 inches deep to bedrock, and areas of Rock outcrop.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; North exposure range site (N-1).

Athena Series

The Athena series consists of deep, gently sloping to very steep, well drained soils that formed in loess and some volcanic ash. The soils are on uplands in the central part of the county. Elevation is 1,600 to 2,500 feet. The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, and hawthorn. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 140 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 20 inches thick. The subsoil, to a depth of 48 inches, is brown and pale brown silt loam. The substratum, to a depth of 60 inches, is light gray calcareous silt loam.

Athena soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Athena soils are used mainly for wheat, barley, peas, alfalfa, grass, range, and wildlife habitat.

Representative profile of Athena silt loam, 7 to 25 percent slopes, 2,400 feet south and 25 feet west of the northeast corner of sec. 19, T. 17 N., R. 42 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; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; neutral; abrupt wavy boundary.

A12-8 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine pores; neutral; clear wavy boundary.

A13-15 to 20 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine and very fine pores; neutral; clear wavy boundary.

B21-20 to 30 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine and very fine pores; neutral; clear wavy boundary.

B22-30 to 48 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to medium prismatic; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few fine pores and common very fine pores; mildly alkaline; abrupt wavy boundary.

Cca-48 to 60 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; massive; hard, friable, slightly sticky

and slightly plastic; few fine roots; few fine pores and common very fine pores; slightly effervescent; strongly alkaline.

Reaction ranges from slightly acid to neutral in the A horizon, neutral to mildly alkaline in the B2 horizon, and mildly alkaline to strongly alkaline in the C horizon. The control section between 10 and 40 inches is 18 to 23 percent clay.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The B2 horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. The C horizon has value of 4 to 6 when moist and 6 to 8 when dry, and it has chroma of 2 to 4 when moist and dry. It is calcareous in some places.

8-Athena silt loam, 3 to 7 percent slopes. This gently sloping soil is on uplands and foot slopes. It has a profile similar to the one described as representative of the series, but the surface layer is about 3 to 4 inches thicker.

Included with this soil in mapping are small areas of soils that are steeper than this Athena soil and soils that have lime at a depth of 20 to 40 inches. Also included are circular areas called slick spots.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for wheat, barley, and peas. Capability unit IIe-2.

9-Athena silt loam, 7 to 25 percent slopes. This strongly sloping and moderately steep soil is on uplands. Most areas of this soil have slopes of 7 to 20 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils where slopes are more than 25 percent or less than 7 percent; areas of soils on severely eroded ridges and knobs, some of which are calcareous; and small circular areas called slick spots.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, and peas. Capability unit IIIe-3.

10-Athena silt loam, 7 to 25 percent slopes, eroded. This strongly sloping and moderately steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is about 10 inches thick.

Included with this soil in mapping are small areas of soils that have lime on the surface and concave areas of soils that have a surface layer more than 20 inches thick.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit IVe-3.

11-Athena silt loam, 25 to 40 percent slopes. This moderately steep and steep soil is on uplands. The areas of this soil that are on north-facing side slopes are generally free from lime, but some areas of this soil on south-, southwest-, and southeast-facing side slopes have lime at a depth of 43 to 60 inches. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 2 to 3 inches thinner.

Included with this soil in mapping are small areas of eroded soils that are on ridges and knobs and that

are calcareous in places, concave areas of soils that have a surface layer as much as 28 inches thick, volcanic ash spots, and Athena soils that have slopes of more than 40 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit IVe-3.

12-Athena silt loam, 25 to 40 percent slopes, eroded. This moderately steep and steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is about 10 inches thick. Many small areas of this soil are shown on the map by a spot symbol.

Included with this soil in mapping are small areas of soils that have lime on the surface and concave areas of soils that have a surface layer more than 20 inches thick.

Runoff is rapid or very rapid, and the hazard of erosion is high or very high.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit VIe-2.

13-Athena silt loam, 40 to 55 percent slopes. This steep and very steep soil is on north-, northwest-, and northeast-facing side slopes. It has a profile similar to the one described as representative of the series, but the surface layer is more than 30 inches thick.

Included with this soil in mapping are small areas of severely eroded soils on ridges and knobs, pumice pockets on north- and northeast-facing side slopes, and soils that are 20 to 40 inches deep to basalt.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; North exposure range site (N-2).

Bakeoven Series

The Bakeoven series consists of nearly level to moderately steep, well drained, very cobbly soils underlain by basalt at a depth of 6 to 10 inches. The soils formed in loess, weathered basalt residuum, and colluvial material. They are on side slopes of channeled scablands and sides of drainageways of the Snake and Palouse Rivers. Elevation is 600 to 2,600 feet. The native vegetation is mainly Sandberg bluegrass and stiff sagebrush. The annual precipitation is 12 to 16 inches. The frost-free season is 130 to 155 days.

In a representative profile the surface layer is grayish brown very cobbly loam and gravelly loam about 5 inches thick. The subsoil is brown very gravelly loam about 3 inches thick. Basalt is at a depth of 8 inches.

Bakeoven soils have moderately slow permeability. The available water capacity is low. Roots penetrate to bedrock. Bakeoven soils are used mainly for range and for wildlife habitat.

Representative profile of Bakeoven very cobbly loam, in an area of Bakeoven-Tucannon complex, 0 to 30 percent slopes, 800 feet east and 300 feet south of the northwest corner of sec. 24, T. 13 N., R. 43 E.:

A11-0 to 1 inch; grayish brown (10YR 5/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plas-

tic; many fine roots; many very fine pores; about 40 percent coarse fragments; neutral; clear wavy boundary.

A12-1 to 5 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many very fine pores; about 40 percent coarse fragments; neutral; clear wavy boundary.

B2-5 to 8 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common very fine pores; about 60 percent coarse fragments; neutral; abrupt wavy boundary.

IIR-8 inches; fractured basalt; fines and few roots in fractures.

Depth to bedrock is 6 to 10 inches. Coarse fragments make up 50 to 75 percent of the profile. The profile ranges from neutral to mildly alkaline throughout. In places, lime and silica coatings are on the undersides of the gravel, cobbles, and stones.

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. It is loam or silt loam and is gravelly, cobbly, very cobbly, or stony. The B horizon has value of 4 or 5 when dry and 3 or 4 when moist. It is loam or clay loam and is very gravelly, cobbly, very cobbly, or stony. Clay films are on some basalt fragments or in fractures in the underlying bedrock.

14-Bakeoven-Tucannon complex, 0 to 30 percent slopes. These soils are on broad basalt plateaus in the northeastern part of the county and on sides of drainageways in the southern part. This complex consists of 40 percent Bakeoven very cobbly loam that has slopes of 0 to 30 percent; 30 percent Tucannon silt loam, 7 to 25 percent slopes; and 20 percent Gwin very cobbly silt loam that has slopes of 3 to 30 percent. The Bakeoven soil has the profile described as representative of the Bakeoven series. The Tucannon soil has a profile similar to the one described as representative of the Tucannon series.

Included with these soils in mapping are steep soils on colluvial slopes, soils that are 20 to 40 inches deep to gravel and cobbles, and Rock outcrop. Included areas make up 10 percent of the mapped acreage of this complex.

Runoff is very slow to rapid, and the hazard of erosion is slight to high.

This complex is used mainly for range and for wildlife habitat. Capability unit VIIIs-1; Bakeoven part in Very Shallow range site and Tucannon part in Loamy range site (L-3).

Beckley Series

The Beckley series consists of nearly level to steep, somewhat excessively drained soils underlain by coarse basaltic sand at a depth of 20 to 40 inches. The soils formed in loess over glacial outwash materials domi-

nantly of basaltic origin. They are on terraces and terrace breaks of channeled scablands and along major drainageways in the western part of the county. Elevation is 700 to 2,000 feet. The native vegetation is mainly bluebunch wheatgrass, Thurber needlegrass, and Sandberg bluegrass. The annual precipitation is 12 to 15 inches. The frost-free season is 135 to 150 days.

In a representative profile the surface layer is grayish brown sandy loam about 14 inches thick. The subsoil, to a depth of 18 inches, is brown coarse sandy loam. The substratum, to a depth of 23 inches, is pale brown coarse sandy loam. Below this, to a depth of 60 inches, it is gray coarse basaltic sand.

Beckley soils have moderately rapid permeability. The available water capacity is low or moderate. Roots penetrate to a depth of 60 inches or more. Beckley soils are used mainly for range and for wildlife habitat. Small areas are used for wheat, barley, alfalfa, and grass.

Representative profile of Beckley sandy loam, 0 to 20 percent slopes, in an area of grassland, 2,600 feet east and 1,200 feet north of the southwest corner of sec. 17, T. 15 N., R. 39 E.:

A11-0 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to weak fine and medium granular; soft, very friable, slightly sticky and slightly plastic; many roots; many fine pores; 5 percent fine basalt gravel; mildly alkaline; clear wavy boundary.

A12-7 to 14 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common roots; many fine and very fine pores; 10 percent fine basalt gravel; mildly alkaline; clear wavy boundary.

B2-14 to 18 inches; brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; many very fine and fine pores; 10 percent fine basalt gravel; mildly alkaline; abrupt wavy boundary.

C1-18 to 23 inches; pale brown (10YR 6/3) coarse sandy loam, dark brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; common roots; 10 percent fine gravel; mildly alkaline; clear wavy boundary.

IIC2-23 to 60 inches; gray (10Y R 5/1) coarse basaltic sand, very dark gray (10YR 3/1) moist; single grained; loose; 5 percent fine gravel; moderately alkaline.

Depth to coarse basaltic sand is 20 to 40 inches. The control section, between depths of 10 and 40 inches, is 3 to 20 percent coarse fragments. The profile is neutral to moderately alkaline throughout.

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 or 5 when dry and 3 or 4 when moist, and it has chroma of 3 or 4 when dry or moist. Some pedons do not have a C horizon. The CI horizon, where present, has value of 5 or 6 when dry and 3 or 4 when moist. The IIC2 horizon contains fine gravel with coatings of lime and fine salts on the undersides.

15-Beckley sandy loam, 0 to 20 percent slopes. This nearly level to moderately steep soil is on terraces of channeled scablands and along major drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils underlain by gravel at a depth of 20 to 40 inches.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, alfalfa, grass, range, and wildlife habitat. Capability unit IIIe-6; Sandy Loam range site.

16-Beckley sandy loam, 20 to 40 percent slopes. This moderately steep and steep soil is on terraces of channeled scablands and along major drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are small areas of soils that have a loam or sandy loam surface layer.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for wheat, barley, alfalfa, grass, range, and wildlife habitat. Capability unit IVE-6; Sandy Loam range site.

Benge Series

The Benge series consists of nearly level to strongly sloping, well drained soils underlain by loose, very gravelly and cobbly loamy sand at a depth of 20 to 40 inches. The soils formed in glacial outwash materials that contained a mixture of loess in the upper part. They are on glacial outwash terraces of channeled scablands in the western part of the county. Elevation is 1,200 to 1,800 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 135 to 150 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 16 inches thick. The subsoil, to a depth of 24 inches, is brown silt loam that is about 6 percent gravel. The substratum, to a depth of 30 inches, is brown very gravelly silt loam. Below this, to a depth of 60 inches, it is very gravelly and cobbly loamy sand.

Benge soils have moderate permeability at a depth of 20 to 40 inches and very rapid permeability at a depth of more than 40 inches. The available water capacity is moderate to moderately high. Roots penetrate to a depth of 60 inches or more. Benge soils are used mainly for wheat, alfalfa, grass, range, and wildlife habitat.

Representative profile of Benge silt loam, 3 to 8 percent slopes, in an area of grassland, 1,100 feet west and 600 feet south of the northeast corner of sec. 33, T. 16 N., R. 39 E.:

A11-0 to 12 inches; dark grayish brown (10YR

4/2) silt loam, very dark brown (10YR 2/2) moist; weak thick platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many roots ; 1 percent very fine gravel ; mildly alkaline; clear smooth boundary.

A12-12 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium sub-angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; 2 percent very fine gravel ; mildly alkaline; clear smooth boundary.

B2-16 to 24 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine pores; 6 percent gravel; mildly alkaline; abrupt wavy boundary.

C1-24 to 30 inches; brown (10YR 5/3) very gravelly silt loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common roots ; 90 percent gravel and cobbles; moderately alkaline; abrupt wavy boundary.

IIC2-30 to 60 inches; very gravelly and cobbly loamy sand; coatings of lime on the underside of some gravel and cobbles; moderately alkaline.

Depth to very gravelly and cobbly loamy sand ranges from 20 to 40 inches but is dominantly 20 to 36 inches. The control section, between depths of 10 and 40 inches, averages less than 10 percent coarse fragments and less than 50 percent fine or coarse sand in the upper part.

The A horizon has value of 4 to 5 when dry and 2 or 3 when moist. It is silt loam or loam and is gravelly in places. The reaction is neutral to mildly alkaline.

17-Benge silt loam, 3 to 8 percent slopes. This gently sloping soil is on outwash terraces of channeled scablands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Rock outcrop, stony soils, and soils underlain by gravel at a depth of more than 40 inches.

Runoff is slow, and the erosion hazard is slight.

This soil is used mainly for wheat, alfalfa, grass, range, and wildlife habitat. Small areas are irrigated. Capability unit IIIe-6; Loamy range site (L-2).

18-Benge complex, 0 to 15 percent slopes. These nearly level to strongly sloping soils are in mounded areas on glacial outwash terraces of the channeled scablands. The complex consists of 55 percent Benge very cobbly silt loam in areas between mounds with slopes mostly between 0 and 15 percent and 25 percent Benge silt loam, 3 to 8 percent slopes, in mounded areas. Most of the slopes of more than 8 percent are along terrace breaks. These soils have a profile similar to the one described as representative of the series, but the Benge very cobbly silt loam that has 0 to 15 percent slopes has a very cobbly surface layer. The mounds

range from 10 to 30 feet in diameter, and they are generally 10 to 30 feet apart. They are generally 1 to 4 feet high.

Included with this complex in mapping are soils that are less than 20 inches or more than 40 inches deep to basalt, very stony soils, wet soils, and Rock outcrops. Included areas make up 20 percent of the mapped acreage of this complex.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

This complex is used for range and wildlife habitat. Capability unit VIIc-1; Loamy range site (L-2).

Caldwell Series

The Caldwell series consists of nearly level, somewhat poorly drained soils that formed in alluvium from loess and some volcanic ash. The soils are on bottom lands in the eastern part of the county. Elevation is 1,700 to 2,600 feet. The native vegetation is mainly tufted hairgrass, sedges, and willow. The annual precipitation is 18 to 23 inches. The frost-free season is 100 to 135 days.

In a representative profile the surface layer is grayish brown and dark gray silt loam about 17 inches thick. The subsoil, to a depth of 39 inches, is gray silty clay loam. The substratum, to a depth of 60 inches, is brownish gray silty clay loam.

Caldwell soils have moderately slow permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Caldwell soils are used mainly for wheat, barley, peas, lentils, clover, grass, range, and wildlife habitat.

Representative profile of Caldwell silt loam, in a cultivated area, 400 feet west and 200 feet north of the southeast corner of sec. 15, T. 15 N., R. 45 E.

Ap-0 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) moist; weak thick platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many roots; common fine pores; neutral; abrupt smooth boundary.

A12-9 to 17 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and slightly plastic; common roots ; common fine pores; neutral; clear smooth boundary.

A3-17 to 26 inches; dark gray (10YR 4/1) heavy silt loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium angular blocky; hard, slightly firm, sticky and plastic; common roots; many fine pores; thin patchy clay films; some organic staining on peds ; gray siliceous coating on vertical peds; neutral; clear smooth boundary.

B2-26 to 39 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky, plastic;

- common roots ; common fine pores; thin patchy clay films; gray silt coatings on peds; neutral; abrupt smooth boundary.
- C1g-39 to 54 inches; light brownish gray (2.5Y 6/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; many fine distinct yellowish brown (10YR 5/6) and brown (7.5YR 4/4) mottles; massive; hard, firm, sticky and plastic; few roots; few fine pores; few very thin clay films; neutral; abrupt smooth boundary.
- C2g-54 to 60 inches; light brownish gray (2.5Y 6/2) light silty clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct mottles; massive; hard, firm, sticky and plastic; no roots ; few fine tubular pores; neutral.

The control section, between depths of 10 and 40 inches, is 25 to 30 percent clay.

The A horizon has value of 3 to 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2. The B horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 when dry and 2 to 4 when moist, and chroma of 1 or 2. Mottles range from faint to distinct and have hue of 7.5YR to 10YR. The gleyed horizon is silty clay loam or heavy silt loam. In places, small pockets of volcanic ash and basalt fragments are in the lower part of the profile.

19-Caldwell silt loam. This nearly level soil is on bottom lands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of poorly drained or moderately well drained soils and areas of soils where coarse sand or basalt are at a depth of 20 to 40 inches.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 2 1/2 to 4 feet.

This soil is used mainly for wheat, barley, peas, lentils, clover, grass, range, and wildlife habitat. Capability unit IIw-2 ; Wet Meadow range site.

20-Caldwell silt loam, drained. This nearly level soil is on bottom lands. It has a profile similar to the one described as representative of the series, but the dark colored surface layer extends to a depth of 40 to 60 inches.

Included with this soil in mapping are areas of somewhat poorly drained soils and small areas of well drained soils.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 3 1/2 to 5 feet. This soil has been artificially drained.

This soil is used mainly for wheat, barley, oats, peas, lentils, clover, grass, and wildlife habitat. Capability unit IIw-2.

Calouse Series

The Calouse series consists of gently sloping to steep, well drained soils that formed in loess and some volcanic ash underlain by calcareous loess. The soils are on ridgetops and south-facing side slopes and are in

the central part of the county. Elevation is 1,500 to 2,600 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 15 to 18 inches. The frost-free season is 120 to 140 days.

In a representative profile the surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil, to a depth of 32 inches, is brown silt loam. The substratum, to a depth of 60 inches, is pale brown and light gray calcareous silt loam.

Calouse soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Calouse soils are used mainly for wheat, barley, peas, alfalfa, and grass.

Representative profile of Calouse silt loam, 7 to 25 percent slopes, in an area of grassland, 1,700 feet north and 80 feet east of the southwest corner of sec. 2, T. 19 N., R. 41 E.:

A11-0 to 6 inches ; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine and fine pores; neutral; abrupt wavy boundary.

A12-6 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine pores ; neutral ; clear wavy boundary.

B21-12 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic ; many very fine and fine roots; many fine and very fine pores; neutral ; clear wavy boundary.

B22-21 to 26 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine and medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine and very fine pores; few dark grayish brown (10YR 4/2) organic coatings on peds and in root channels; neutral; clear wavy boundary.

B3-26 to 32 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard; friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; few fragments and coatings of lime in pores and root channels ; slightly effervescent, moderately alkaline; abrupt wavy boundary.

C1ca-32 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; common very fine and fine roots; many very fine and fine pores; lime throughout the matrix and concentrated in pores and root channels; violently effervescent; moderately alkaline; clear wavy boundary.

C2ca-37 to 48 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine pores; lime in root channels and pores; strongly effervescent; moderately alkaline; clear wavy boundary.

C3ca-48 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; very hard, very firm, slightly sticky and slightly plastic; few roots; very fine and fine pores; lime in pores; strongly effervescent; moderately alkaline.

The profile is neutral to moderately alkaline throughout. The control section between depths of 10 and 40 inches is 18 to 23 percent clay. Depth to secondary lime 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 B2 and B3 horizons have value of 5 or 6 when dry or 3 or 4 when moist, and they have chroma of 3 or 4 when dry or moist. They are silt loam or light silty clay 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.

21-Calouse silt loam, 3 to 7 percent slopes. This gently sloping soil is on south-facing side slopes on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker (fig. 15).

Included with this soil in mapping are soils that have lime at a depth of more than 40 inches.

Runoff is slow, and the erosion hazard is slight. This soil is used mainly for wheat, barley, and peas.

Capability unit IIe-2.

22-Calouse silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on south-facing side slopes on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that have lime at a depth of more than 40 inches and areas of severely eroded soils, some of which are calcareous and are on narrow ridgetops and knobs.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, and peas.

Capability unit IIIe-3.

23-Calouse silt loam, 5 to 25 percent slopes, eroded. This gently sloping to moderately steep soil is on ridgetops, knobs, and south-facing side slopes on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 6 to 8 inches thick.

Included with this soil in mapping are concave areas

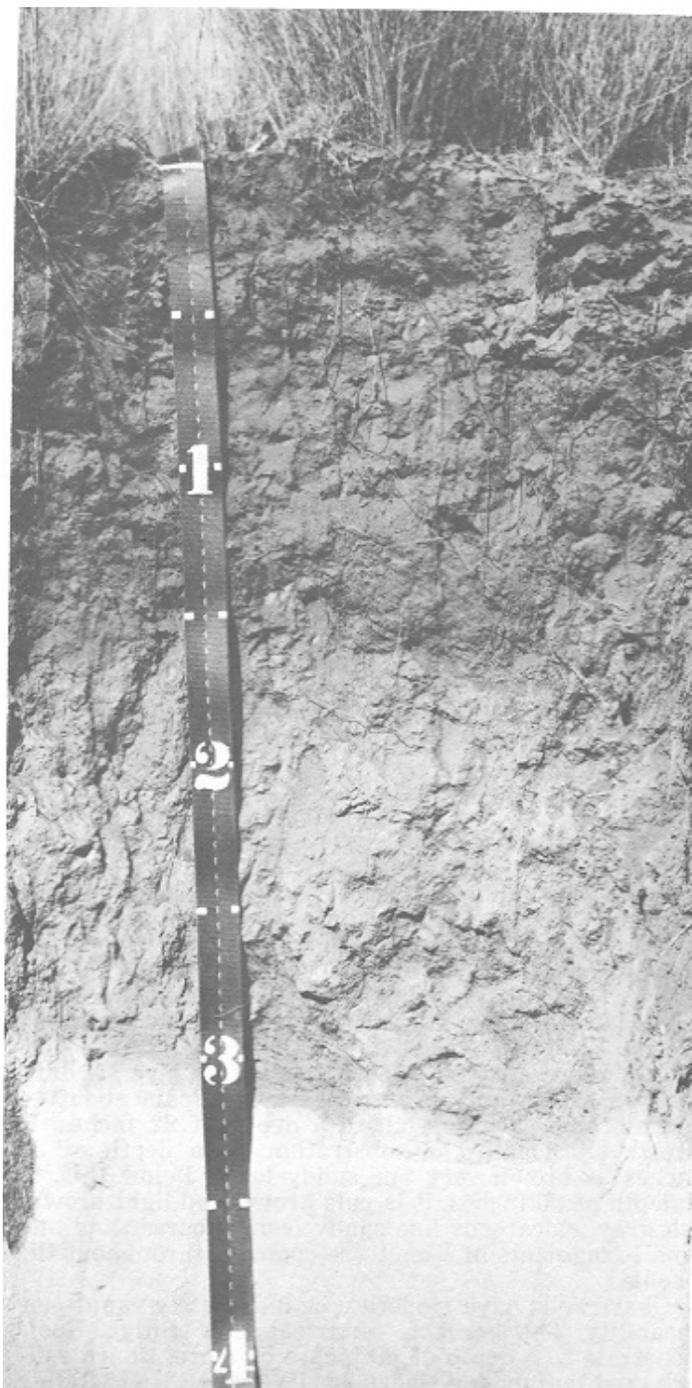


Figure 15.-Profile of Calouse silt loam, 3 to 7 percent slopes. The lime accumulation is at a depth of about 3 feet.

of soils that have a surface layer 10 to 18 inches thick and lime at a depth of more than 40 inches. Also included are areas, on the ridgetops and knobs, of soils that have lime at a depth of less than 20 inches.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit IVE-3.

24-Calouse silt loam, 25 to 40 percent slopes. This moderately steep to steep soil is on south-facing side slopes on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 7 to 9 inches thick.

Included with this soil in mapping are spots of severely eroded soils that are generally calcareous and are on the narrow ridgetops and knobs. Also included are concave areas of soils that have a surface layer more than 18 inches thick and that have lime at a depth of more than 40 inches.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit IVE-3.

25-Calouse silt loam, 25 to 40 percent slopes, eroded. This moderately steep and steep soil is on knobs and south-facing side slopes on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 4 to 6 inches thick.

Included with this soil in mapping are concave areas of soils that have a surface layer 10 to 18 inches thick and that have lime at a depth of more than 40 inches. Also included are areas of soils that have lime at a depth of less than 20 inches on the ridgetops and knobs.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit VIe-2.

Chard Series

The Chard series consists of gently sloping to moderately steep, well drained soils that formed in loess and small amounts of volcanic ash and glacial outwash material. The soils are on terraces that border channeled scablands and the Snake and Palouse Rivers and their tributaries. Elevation is 600 to 1,700 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 135 to 150 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 14 inches thick. The subsoil, to a depth of 22 inches, is brown silt loam. The substratum, to a depth of 32 inches, is brown very fine sandy loam. Below this, to a depth of 60 inches, it is pale brown and light brownish gray, calcareous fine sandy loam. Coarse sand and small fragments of basalt are common throughout the profile.

Chard soils have moderate or moderately rapid permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Chard soils are used mainly for wheat, barley, range, and wildlife habitat. Small areas are irrigated.

Representative profile of Chard silt loam, 7 to 15 percent slopes, in a cultivated field, 1,300 feet west and 1,000 feet north of the southeast corner of sec. 15, T. 15 N., R. 39 E.

Ap-0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very

fine and fine roots; mildly alkaline ; abrupt smooth boundary.

A12-6 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine pores; mildly alkaline; clear wavy boundary.

B2-14 to 22 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine and medium prismatic structure parting to fine and medium subangular blocky; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine and fine pores ; moderately alkaline; clear wavy boundary.

IIC1-22 to 32 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common roots ; many fine and very fine pores; 10 percent coarse and very coarse basalt sand; moderately alkaline; clear wavy boundary.

IIC2ca-32 to 40 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few roots; many fine pores; 15 percent coarse and very coarse basalt sand; strongly effervescent; moderately alkaline; clear wavy boundary.

IIC3ca-40 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine and fine roots ; 20 percent coarse and very coarse basalt sand; strongly effervescent; moderately alkaline.

The control section, between depths of 10 and 40 inches, is less than 5 percent coarse fragments. It is silt loam in the upper part and loam, very fine sandy loam, or fine sandy loam in the lower part. Depth to secondary carbonates is 28 to 40 inches.

Thickness of the A11 and A12 horizons ranges from 10 to 18 inches. The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is silt loam, loam, or very fine sandy loam and is neutral to mildly alkaline. The B2 horizon has value of 4 or 5 when dry. It is silt loam, loam, or very fine sandy loam and is neutral to mildly alkaline. The IIC1 and IIC2ca horizons have value of 5 or 6 when dry and 3 or 4 when moist, and they have chroma of 2 to 4 when dry or moist. They are very fine sandy loam, fine sandy loam, or sandy loam. Lenses of coarse sand and gravel are in the IIC1 and IIC2ca horizons.

26-Chard silt loam, 3 to 7 percent slopes. This gently sloping soil is on terraces. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thicker.

Included with this soil in mapping are areas of soils

that have a sandy loam surface layer, soils that have sand and gravel at a depth of 20 to 40 inches, and soils that are silt loam to a depth of 60 inches.

Runoff is slow, and the erosion hazard is slight.

This soil is used mainly for wheat, barley, range, and wildlife habitat. Capability unit IIe-1; Loamy range site (L-2).

27-Chard silt loam, 7 to 15 percent slopes. This strongly sloping soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have a sandy loam surface layer, soils that have sand and gravel at a depth of 20 to 40 inches, and soils that are silt loam to a depth of 60 inches.

Runoff is medium, and the erosion hazard is moderate.

This soil is used for wheat, barley, range, and wildlife habitat. Capability unit IIIe-2; Loamy range site (L-2).

28-Chard silt loam, 15 to 25 percent slopes. This moderately steep soil is on terraces. It has a profile similar to the one described as representative of the series, but the surface layer is 3 to 5 inches thinner.

Included with this soil in mapping are areas of soils that have a sandy loam surface layer, soils that have sand and gravel at a depth of 20 to 40 inches, and soils that are silt loam to a depth of 60 inches.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, range, and wildlife habitat. Capability unit IIIe-2; Loamy range site (L-2).

Cheney Series

The Cheney series consists of nearly level to moderately steep, well drained soils underlain by sand, gravel, and cobbles at a depth of 20 to 40 inches. The soils formed in glacial outwash, loess, and volcanic ash. They are on terraces in channeled scablands in the northwestern part of the county. Elevation is 1,700 to 2,200 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 140 days.

In a representative profile the surface layer is dark grayish brown silt loam about 16 inches thick. The subsoil, to a depth of 29 inches, is brown gravelly loam. The substratum, to a depth of 36 inches, is brown very gravelly loam. Below this, to a depth of 60 inches, it is gravel, sand, and cobbles.

Cheney soils have moderate permeability. The available water capacity is moderate or moderately high. Roots penetrate to a depth of 60 inches or more. Cheney soils are used mainly for wheat, barley, range, and wildlife habitat.

Representative profile of Cheney silt loam, 0 to 7 percent slopes, in an area of grassland, 2,200 feet west and 1,200 feet south of the northeast corner of sec. 17, T. 20 N., R. 43 E.:

A11-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky

and slightly plastic; many roots; neutral; abrupt smooth boundary.

A12-7 to 16 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; 5 percent gravel; neutral; clear wavy boundary.

B2-16 to 29 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/4) moist; tweak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine pores; slightly effervescent on underside of some pebbles; 15 percent gravel; mildly alkaline; clear wavy boundary.

C1-29 to 36 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine tubular pores; 40 percent gravel; slightly effervescent on underside of some pebbles; mildly alkaline; clear wavy boundary.

IIC2-36 to 60 inches; sand, gravel, and cobbles, dominantly basalt, few granite and quartzite; some pebbles and cobbles have lime coatings on underside.

Depth to sand, gravel, and cobbles ranges from 20 to 40 inches.

The A horizon is loam or silt loam and in places is very cobbly. Thickness of the A11 and A12 horizons ranges from 10 to 18 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is neutral to mildly alkaline. The B2 horizon has value of 4 or 5 when dry and 3 when moist, and it has chroma of 3 or 4 when dry or moist. It is silt loam or loam and in places is gravelly. The C1 horizon has value of 5 or 6 when dry and 3 when moist, and it has chroma of 3 or 4 when dry or moist. It ranges from very gravelly sandy loam to very gravelly loam and is as much as 60 percent coarse fragments.

29-Cheney silt loam, 0 to 7 percent slopes. This nearly level to gently sloping soil is on glacial outwash terraces. It has the profile described as representative of the series.

Included with this soil in mapping are soils with gravel, cobbles, and sand at a depth of more than 40 inches; very stony soils; soils with basalt at a depth of 20 to 40 inches; and Rock outcrop.

Runoff is very slow or slow, and the erosion hazard is slight.

This soil is used mainly for wheat, barley, range, and wildlife habitat. Capability unit IIIe-7; Loamy range site (L-3).

30-Cheney very cobbly silt loam, 0 to 20 percent slopes. This nearly level to moderately steep soil is on glacial outwash terraces. It has a profile similar to the one described as representative of the series, but the surface layer is very cobbly and the subsoil has a higher percentage of gravel and cobbles.

Included with this soil in mapping are areas of soils

that are stony, soils with basalt at a depth of 10 to 40 inches, soils that do not have cobbles to a depth of 20 to 40 inches, and Rock outcrop.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for range and for wildlife habitat. Capability unit VIs-1 ; Loamy range site (L-3).

Covello Series

The Covello series consists of nearly level, somewhat poorly drained soils that formed in alluvium from loess and varying amounts of volcanic ash. The soils are on bottom lands in the central part of the county. Elevation is 1,500 to 2,200 feet. The native vegetation is mainly tufted hairgrass, sedges, and willows. The annual precipitation is 15 to 20 inches. The frost-free season is 130 to 145 days.

In a representative profile the surface layer is dark grayish brown and grayish brown, calcareous silt loam about 30 inches thick. The underlying material, to a depth of 51 inches, is white silt loam. Beneath this, to a depth of 60 inches, is light brownish gray light silty clay loam.

Covello soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Covello soils are used mainly for wheat, barley, legumes, grass, range, and wildlife habitat.

Representative profile of Covello silt loam, in an area of grass, 650 feet south and 400 feet east of the northwest corner of sec. 20, T. 16 N., R. 43 E.:

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A12-7 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure or massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine and medium pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

A13-11 to 19 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots ; common fine and medium pores; slightly effervescent; moderately alkaline; clear wavy boundary.

A14-19 to 30 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 fine roots; many fine and very fine pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIC1-30 to 51 inches; white (10YR 8/1) silt loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable, nonsticky and nonplastic ; very few fine roots; common fine and medium pores; moderately alkaline; abrupt wavy boundary.

IIC2-51 to 60 inches; light brownish gray (10YR 6/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; very few fine roots; common. fine and medium pores; moderately alkaline.

The control section, between depths of 10 and 40 inches, is 12 to 18 percent clay. In places it has subhorizons of very fine sandy loam or light silty clay loam. The profile is mildly to moderately alkaline throughout, and slight effervescence may occur in any horizon.

Thickness of the A horizon ranges from 24 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 1 or 2 when dry or moist. The C horizon has value of 6 to 8 when dry and 4 to 6 when moist. A few large, distinct mottles are in the C horizon.

31-Covello silt loam. This nearly level soil is on bottom lands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that are strongly alkaline, soils that are moderately well drained, and soils that are not calcareous in the surface layer or subsoil.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is within 2 to 4 feet of the surface.

This soil is used mainly for wheat, barley, legumes, grass, range, and wildlife habitat. Capability unit IIw-1; Wet Meadow range site.

32-Covello silt loam, drained. This nearly level soil is on bottom lands.

Included with this soil in mapping are areas of soils that are strongly alkaline. Soils that are somewhat poorly drained, and soils that are not calcareous.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 3 to 5 feet. This soil has been drained.

This soil is used mainly for wheat, barley, legumes, grass, and wildlife habitat. Capability unit IIw-1.

Emdent Series

The Emdent series consists of nearly level, somewhat poorly drained, saline-alkali soils that formed in alluvial material from loess and volcanic ash. The soils are in depressions, basins, and potholes in the southwestern part of the county. Elevation is 900 to 1,900 feet. The native vegetation is mainly giant wildrye and saltgrass. The annual precipitation is 11 to 16 inches. The frost-free season is 135 to 145 days.

In a representative profile the surface layer is grayish brown, strongly alkaline silt loam about 9 inches thick. The next layer, to a depth of 15 inches, is light gray, strongly alkaline silt loam. The underlying ma-

terial, to a depth of 22 inches, is light gray, strongly alkaline silt loam. Next, to a depth of 46 inches, it is light gray and white silt loam and loam. Below this, to a depth of 60 inches, it is gray light silty clay loam.

Eminent soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Eminent soils are used mainly for range and for wildlife habitat. Cultivated areas are used for wheat, barley, oats, legumes, and grass.

Representative profile of Eminent silt loam, in an area of grassland, 2,050 feet south and 300 feet west of the northeast corner of sec. 18, T. 14 N., R. 37 E.:

Alca-0 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak very thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; violently effervescent; strongly alkaline; abrupt smooth boundary.

ACca-9 to 15 inches; light gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.

Clca-15 to 22 inches; light gray (10YR 7/1) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many roots; few fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.

C2ca-22 to 29 inches; light gray (10YR 7/1) silt loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; many interstitial pores; violently effervescent; moderately alkaline; clear wavy boundary.

C3-29 to 46 inches; white (10YR 8/1) loam, light gray (10YR 7/2) and pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; few roots; many interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C4g-46 to 60 inches; gray (5Y 6/1) silty clay loam, olive gray (5Y 4/2) moist; moderate fine angular blocky structure; hard, firm, sticky and plastic; common fine tubular pores; thin continuous clay films on ped faces; strongly effervescent; moderately alkaline.

The profile is moderately alkaline to strongly alkaline throughout and is slightly effervescent to violently effervescent in all horizons. The control section, between depths of 10 and 40 inches, is more than 60 percent volcanic ash and 12 to 18 percent clay.

The A1 horizon is 8 to 14 inches thick. It has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. The C1ca, C2ca, and C3 horizons have value of 6 to 8 when dry and 5 to 7 when moist, and they have chroma of 2 or 3 when

moist and 1 when dry. The C4g horizon, where present, is silt loam or silty clay loam. It has hue of 5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 1 or 2 when dry or moist.

33-Eminent silt loam. This nearly level soil is in depressions, basins, and potholes. It has the profile described as representative of the series.

Included with this soil in mapping are a few areas of moderately well drained or well drained soils, areas of soils that have bedrock at a depth of 20 to 40 inches, and areas of Rock outcrop.

Runoff is ponded or very slow, and there is little or no hazard of erosion. This soil is subject to ponding during winter and spring. A seasonally high water table is at a depth of 2 to 4 feet.

This soil is used mainly for range and for wildlife habitat. Capability unit VIw-1; Alkali range site.

34-Eminent silt loam, drained. This nearly level soil is in depressions and basins. It has a profile similar to the one described as representative of the series, but the surface layer is 10 to 12 inches of recent alluvium.

Included with this soil in mapping are areas of somewhat poorly drained soils and areas of soils that have bedrock at a depth of 20 to 40 inches.

Runoff is ponded or very slow, and there is little or no hazard of erosion. This soil is subject to ponding during winter and spring. A seasonally high water table is at a depth of 3 to 5 feet.

This soil is used mainly for legumes, grass, wheat, barley, oats, range, and wildlife habitat. Capability unit IVw-2; Alkali range site.

Endicott Series

The Endicott series consists of gently sloping to strongly sloping, well drained soils that have a lime-silica cemented hardpan at a depth of 20 to 40 inches. The soils formed in loess and some volcanic ash. They are on narrow ridgetops, southwest-facing side slopes, and terraces. Elevation is 1,700 to 2,200 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 135 to 155 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 13 inches thick. The subsoil, to a depth of 29 inches, is brown silt loam. The substratum, to a depth of 39 inches, is a white, indurated, lime-silica cemented hardpan. Below this, to a depth of 60 inches, the substratum is pale brown silt loam.

Endicott soils have moderate permeability to a depth of 20 to 40 inches and very slow permeability in the cemented area. The available water capacity is moderate or moderately high. Roots penetrate to the hardpan. Endicott soils are used mainly for wheat, barley, range, and wildlife habitat.

Representative profile of Endicott silt loam, 3 to 15 percent slopes, in a cultivated field, 200 feet west and 1,100 feet north of the southeast corner of sec. 24, T. 17 N., R. 39 E.:

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic;

- many roots; many fine and very fine pores; neutral ; abrupt smooth boundary.
- A12-7 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many fine and very fine pores; neutral ; clear wavy boundary.
- B21-13 to 23 inches; brown (10YR 5/3) silt loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine and very fine pores; mildly alkaline ; gradual wavy boundary.
- B22-23 to 29 inches; brown (10YR 5/3) silt loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine and very fine pores; mildly alkaline; gradual wavy boundary.
- C1sim-29 to 39 inches; white (10YR 8/2) layers of indurated lime-silica cemented hardpan lenses that do not break down on acid treatment alone; indurated layers separated by light grayish brown (10YR 6/2) silt loam; few roots extend into cracks; strongly effervescent; moderately alkaline; clear wavy boundary.
- C2ca-39 to 60 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; violently effervescent; strongly alkaline.

Depth to the lime-silica hardpan ranges from 20 to 40 inches.

Thickness of the A horizon ranges from 7 to 18 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. The C1sim horizon has value of 6 to 8 when dry and 4 to 6 when moist, and it has chroma of 1 to 4 when dry or moist. It consists of indurated, lime-silica-cemented layers separated by lenses of friable, calcareous material. The C2ca horizon has value of 6 to 8 when dry and 4 to 6 when moist. Fragments of lime-silica-cemented materials are common throughout the profile.

35-Endicott silt loam, 3 to 15 percent slopes. This gently sloping to strongly sloping soil is on narrow ridgetops, south-facing side slopes, and terraces.

Included with this soil in mapping are areas of soil that do not have the indurated, lime-silica hardpan and soils that are underlain by basalt at a depth of 20 to 40 inches.

Runoff is slow or medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, barley, and range. Capability unit IIIe-2 ; Loamy range site (L-2).

Farrell Series

The Farrell series consists of nearly level to moderately steep, well drained soils that formed in glacial

outwash from loess, volcanic ash, and basalt. The soils are on terraces that border channeled scablands, are along the Snake River valley, and are in the southwestern part of the county. Elevation is 800 to 1,400 feet. The native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The annual precipitation is 11 to 12 inches. The frost-free season is 140 to 150 days.

In a representative profile the surface layer is grayish brown very fine sandy loam about 7 inches thick. The subsoil, to a depth of 20 inches, is brown very fine sandy loam. The substratum, to a depth of 53 inches, is light brownish gray, calcareous very fine sandy loam and fine sandy loam. Below this, to a depth of 60 inches is light grayish brown, coarse basaltic sand.

Farrell soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Farrell soils are used mainly for wheat, alfalfa, grass, range, and wildlife habitat.

Representative profile of Farrell very fine sandy loam, 7 to 25 percent slopes, in an area of grass, 3,040 feet east and 2,960 feet south of the northwest corner of sec. 34, T. 14 N., R. 34 E.:

- Ap-0 to 7 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots ; mildly alkaline; clear smooth boundary.
- B2-7 to 20 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; moderately alkaline; abrupt smooth boundary.
- C1ca-20 to 39 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; common fine pores; violently effervescent; strongly alkaline; clear wavy boundary.
- C2ca-39 to 53 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; common fine pores; violently effervescent; strongly alkaline; clear wavy boundary.
- IIIC3-53 to 60 inches; light grayish brown (10YR 6/2) coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose; few roots; slightly effervescent; moderately alkaline.

Depth to secondary carbonates ranges from 20 to 40 inches.

Thickness of the A horizon ranges from 7 to 10 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is very fine sandy loam or fine sandy loam. The B2 horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is 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. It is loam, very fine sandy loam, fine sandy loam, or coarse sandy loam. It is moderately alkaline or strongly alkaline and is slightly effervescent to violently effervescent.

36-Farrell very fine sandy loam, 0 to 7 percent slopes. This nearly level and gently sloping soil is on terraces. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker.

Included with this soil in mapping are soils that are 20 to 40 inches deep to basaltic sand, silt loams more than 60 inches deep, and soils that have basalt near the surface.

Runoff is very slow to slow, and the erosion hazard is slight.

This soil is used mainly for wheat, alfalfa, grass, range, and wildlife habitat. Capability unit IIIe-1; Loamy range site (L-2).

37-Farrell very fine sandy loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are soils that are 20 to 40 inches deep to basaltic sand, silt loams more than 60 inches deep, and soils that have basalt bedrock at a depth of 10 inches or less.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, alfalfa, grass, range, and wildlife habitat. Capability unit IIIe-1; Loamy range site (L-2).

Garfield Series

The Garfield series consists of gently sloping to moderately steep, well drained, severely eroded soils that formed in loess. The soils are on low-lying ridgetops and knobs in the eastern part of the county. Elevation is 1,900 to 3,000 feet. The native vegetation is mainly Idaho fescue and bluebunch wheatgrass. The annual precipitation is 18 to 23 inches. The frost-free season is 110 to 140 days.

In a representative profile the surface layer is brown silty clay loam about 6 inches thick. The subsoil extends to a depth of 60 inches. It is yellowish brown silty clay loam to a depth of 27 inches and light yellowish brown silty clay loam below.

Garfield soils have slow permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Garfield soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa.

Representative profile of Garfield silty clay loam, 3 to 25 percent slopes, in a cultivated field 1,900 feet west and 1,900 feet south of the northeast corner of sec. 30, T. 15 N., R. 45 E.:

Ap-0 to 8 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, firm, sticky and plastic; common very fine and fine roots; many fine pores; slightly acid; abrupt smooth boundary.

B21t-8 to 27 inches; yellowish brown (10YR 5/4) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic

structure parting to strong fine angular blocky; very hard, very firm, sticky and plastic; many very fine and fine roots; few very fine pores and many medium pores; continuous thin clay films on peds; very dark brown (10YR 2/2) moist stains on peds; common fine concretions; neutral; clear wavy boundary.

B22t-27 to 48 inches; light yellowish brown (10YR 6/4) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to strong fine angular blocky; very hard, very firm, sticky and plastic; few very fine and fine roots; common very fine pores and many medium pores; continuous thin clay films on peds; very dark brown (10YR 2/2) moist stains on peds; common fine concretions; mildly alkaline; abrupt wavy boundary.

B3-48 to 60 inches; light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure parting to strong fine angular blocky; very hard, very firm, sticky and plastic; few fine roots; few fine pores; few very dark brown (10YR 2/2) moist stains on peds; few fine concretions; many thin clay films on peds; neutral.

The Ap horizon has value of 4 or 5 when dry and 3 or 4 when moist, chroma of 2 or 3, and hue of 7.5YR to 10YR. It is slightly acid to neutral. The B2t horizon is 35 to 45 percent clay. It has value of 5 or 6 when dry and 3 or 4 when moist, chroma of 3 or 4, and hue of 7.5YR to 10YR. Few to common fine concretions are in the B2t horizon. Few to common very dark brown (10YR 2/2) moist stains are on peds. In a few places calcium carbonate has accumulated in the lower part of the B2 horizon. Reaction is neutral to moderately alkaline. The B3 horizon has value of 5 or 6 dry and 4 or 5 moist, and it has chroma of 3 or 4. It is heavy silt loam to silty clay loam and is neutral to moderately alkaline.

38-Garfield silty clay loam, 3 to 25 percent slopes.

This gently sloping to moderately steep soil is on low lying ridgetops and knobs.

Included with this soil in mapping are soils that have lime on the surface, silt loams more than 60 inches deep, and soils that have a silt loam surface layer underlain by a silty clay or silty clay loam subsoil.

Runoff is slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVE-10.

Gwin Series

The Gwin series consists of gently sloping to very steep, well drained, cobbly soils underlain by basalt at a depth of 10 to 20 inches. The soils formed in colluvium from loess, volcanic ash, and residuum weathered from basalt. They are on south-facing valley walls and in channeled scablands in the eastern and northeastern parts of the county. Elevation is 1,600 to 3,000 feet.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The annual precipitation is 18 to 23 inches. The frost-free season is 115 to 145 days.

In a representative profile the surface layer is dark grayish brown cobbly silt loam about 7 inches thick. The subsoil, to a depth of 13 inches, is brown very gravelly heavy silt loam. Below this, it is grayish brown very gravelly heavy silt loam. Basalt is at a depth of 18 inches.

Gwin soils have moderately slow permeability. The available water capacity is low. Roots penetrate to bedrock. Gwin soils are used mainly for range and for wildlife habitat. They are mapped only in complex with Tucannon and Linville soils.

Representative profile of Gwin cobbly silt loam, in an area of Gwin-Tucannon complex, 3 to 30 percent slopes, 1,450 feet south of the east quarter-corner of sec. 6, T. 15 N., R. 43 E.:

A1-0 to 7 inches; dark grayish brown (10YR 4/2) cobbly silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; 30 percent coarse fragments; neutral; clear smooth boundary.

B21t-7 to 13 inches; brown (10YR 5/3) very gravelly heavy silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, sticky and plastic; many roots; many fine pores; thin almost continuous clay films on vertical ped faces; faint light gray (10YR 7/2) coatings on all ped faces; 60 percent angular basalt fragments; neutral; clear wavy boundary.

B22t-13 to 18 inches; grayish brown (10YR 5/2) very gravelly heavy silt loam, dark grayish brown (10YR 4/2) moist; weak fine blocky structure; hard, friable, sticky and plastic; common roots; many fine tubular pores; thin continuous clay films; 70 percent angular basalt fragments; neutral; abrupt irregular boundary.

R-18 inches; basalt, somewhat fractured.

Depth to bedrock ranges from 10 to 20 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2. It is 6 to 8 inches thick and is neutral to slightly acid. It is 3 to 30 percent angular basalt gravel, cobbles, and stones. The B horizon has value of 4 to 6 when dry and 3 or 4 when moist, chroma of 2 or 3 when dry or moist, and hue of 7.5YR and 10YR. It ranges from heavy silt loam to silty clay loam. It is 50 to 80 percent angular basalt fragments. In places, the bedrock has a very thin coating of calcium carbonate.

39-Gwin-Linville complex, 30 to 65 percent slopes.

These steep to very steep soils are on south-facing valley walls. This complex consists of 60 percent Gwin cobbly silt loam that has slopes 30 to 65 percent and 25 percent Linville silt loam, 30 to 65 percent slopes.

Included with these soils in mapping are areas that are as much as 15 percent Rock outcrop, areas of very

gravelly loams that are less than 10 inches deep to basalt, areas of stony and very stony soils, and areas of silt loams more than 60 inches deep.

Runoff is rapid or very rapid, and the erosion hazard is high or very high.

These soils are used mainly for range and for wildlife habitat. Capability unit VIIs-1; Gwin part in Shallow range site (S-3), Linville part in North exposure range site (N-2).

40-Gwin-Tucannon complex, 3 to 30 percent slopes.

These gently sloping to moderately steep soils are on south-facing side slopes in valleys. This complex consists of 60 percent Gwin cobbly silt loam that has slopes of 3 to 30 percent and 25 percent Tucannon silt loam, 7 to 25 percent slopes. The Gwin soil has the profile described as representative of the Gwin series.

Included with these soils in mapping are areas that are as much as 15 percent Rock outcrop, areas of very gravelly loams less than 10 inches deep to bedrock, areas of stony and very stony soils, and areas of silt loams more than 60 inches deep.

Runoff is slow to medium, and the erosion hazard is slight or moderate.

These soils are used mainly for range and for wildlife habitat. Capability unit VIIs-1; Gwin part in Shallow range site (S-3), Tucannon part in Loamy range site (L-3)

Hermiston Series

The Hermiston series consists of nearly level, well drained soils that formed in alluvium from loess and volcanic ash. The soils are on bottom lands and low terraces along the Snake River Valley and in drainage-ways in the western part of the county. Elevation is 900 to 2,000 feet. The native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and giant wildrye. The annual precipitation is 12 to 17 inches. The frost-free season is 130 to 155 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 17 inches thick. The next layer, to a depth of 22 inches, is brown silt loam. The underlying material, to a depth of 60 inches, is light gray and very pale brown very fine sandy loam and silt loam.

Hermiston soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Hermiston soils are used mainly for wheat, barley, and wildlife habitat.

Representative profile of Hermiston silt loam, in a cultivated area, 2,500 feet east and 2,700 feet south of the northwest corner of sec. 15, T. 15 N., R. 39 E.:

Ap-0 to -5 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; neutral; clear wavy boundary.

A12-5 to 17 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly

hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots ; many very fine and fine pores ; mildly alkaline; clear wavy boundary.

AC-17 to 22 inches ; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots ; many very fine and fine pores; mildly alkaline; clear wavy boundary.

C1ca-22 to 30 inches; light gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine pores ; slightly effervescent ; moderately alkaline; abrupt wavy boundary.

C2ca-30 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine pores; violently effervescent ; strongly alkaline.

Depth to secondary lime ranges from 20 to 30 inches.

The control section, between depths of 10 and 40 inches, is 12 to 18 percent clay.

Thickness of the A and AC horizons is more than 30 inches in places. These horizons have value of 2 or 3 when moist and 4 or 5 when dry, and they have chroma of 2 or 3. They are neutral to moderately alkaline. The Cca horizon has value of 4 or 5 when moist and 5 to 7 when dry, and it has chroma of 2 or 3.

41-Hermiston silt loam. This nearly level soil is on bottom lands and low terraces.

Included with this soil in mapping are areas of soils that are not calcareous to a depth of 60 inches, areas of soils that are silt loam to a depth of 60 inches, and small areas of soils that are moderately alkaline to strongly alkaline throughout.

Runoff is very slow, and there is little or no hazard of erosion. Flooding sometimes occurs during unusual weather conditions.

This soil is used mainly for wheat, barley, and wildlife habitat. Capability unit IIc-1.

Hesseltine Series

The Hesseltine series consists of nearly level to moderately steep, well drained, cobbly soils underlain by water-worn loose sand, gravel, and cobbles at a depth of 20 to 40 inches. The soils formed in a thin mantel of loess and volcanic ash underlain by glacial outwash. They are on outwash terraces of channeled scablands in the northwestern part of the county. Elevation is 1,600 to 2,200 feet. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and ponderosa pine. The annual precipitation is 17 to 19 inches. The frost-free season is 120 to 140 days.

In a representative profile the surface layer is brown cobbly silt loam and gravelly loam about 7 inches thick. The subsoil, to a depth of 20 inches, is yellowish brown gravelly loam. The substratum, to a depth of 34 inches,

is brown very gravelly sandy loam. Below a depth of 34 inches, it is water-worn loose sand, gravel, and cobbles.

Hesseltine soils have moderate permeability to a depth of 20 to 40 inches and very rapid permeability at a depth of more than 40 inches. The available water capacity is moderate. Roots penetrate to a depth of 60 inches or more. Hesseltine soils are used mainly for woodland grazing and for wildlife habitat.

Representative profile of Hesseltine cobbly silt loam, 0 to 30 percent slopes, in an area of woodland, 1,700 feet east and 1,900 feet north of the southwest corner of sec. 8, T. 20 N., R. 43 E.:

A1-0 to 4 inches ; brown (10YR 5/3) cobbly silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; few fine pores; 15 percent gravel and cobbles; neutral; abrupt smooth boundary.

A3-4 to 7 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure ; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine pores; 15 percent gravel and cobbles ; distinct gray coatings on vertical ped faces; neutral; clear smooth boundary.

B1-7 to 15 inches; yellowish brown (10YR 5/4) gravelly loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots ; few fine pores; 15 percent gravel and cobbles; thin patchy clay films on peds; distinct gray coatings on peds; neutral; clear smooth boundary.

B2t-15 to 20 inches; yellowish brown (10YR 5/4) gravelly loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine pores; 35 percent gravel and cobbles; thin continuous clay films on peds ; distinct gray coatings on peds; neutral ; clear smooth boundary.

C1-20 to 27 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine pores; 60 percent gravel and cobbles; neutral; clear smooth boundary.

C2-27 to 34 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine pores; 70 percent gravel and cobbles; neutral; abrupt wavy boundary.

IIc3-34 inches; loose sand, gravel, and cobbles

containing a small amount of fine material.

Depth to sand, gravel, and cobbles ranges from 20 to 40 inches. The profile is slightly acid to neutral throughout.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. Content of coarse fragments in the B2t horizon ranges from 35 to 50 percent. The C1 and C2 horizons have value of 4 or 5 when dry and 3 or 4 when moist, and they have chroma of 3 or 4. They are 35 to 70 percent gravel.

42-Hesseltine cobble silt loam. 0 to 30 percent slopes. This nearly level to moderately steep soil is on glacial outwash terraces.

Included with this soil in mapping are areas of soils that are less than 20 inches deep to basalt, stony areas, small areas that are free of surface cobbles, and areas of Rock outcrop.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used mainly for woodland grazing and for wildlife habitat. Capability unit VI-1.

Konert Series

The Konert series consists of nearly level, somewhat poorly drained soils that formed in alluvial material from loess, weathered metasediment, and volcanic ash. The soils are on bottom lands and alluvial fans adjacent to buttes in the eastern part of the county. Elevation is 2,000 to 2,800 feet. The native vegetation is mainly reed canarygrass, willows, and hawthorne. The annual precipitation is 20 to 23 inches. The frost-free season is 90 to 110 days.

In a representative profile the surface layer is dark gray silty clay loam about 20 inches thick. The subsoil, to a depth of 41 inches, is gray silty clay loam in the upper part and gray silty clay in the lower part. The substratum, to a depth of 60 inches, is gray silt loam.

Konert soils have slow permeability. The available water capacity is high. Root penetration is limited by the water table and by the silty clay in the lower part of the subsoil. Konert soils are used mainly for wheat, barley, legumes, grass, range, and wildlife habitat.

Representative profile of Konert silty clay loam, in an area of grassland, 1,400 feet east and 1,000 feet north of the southwest corner of sec. 20, T. 14 N., R. 46 E.:

A11-0 to 4 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; strong very fine and fine granular structure; hard, firm, sticky and plastic; many roots; many very fine pores; neutral; abrupt smooth boundary.

A12-4 to 13 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; strong very fine and medium subangular blocky structure; hard, firm, sticky and plastic; common roots; many fine pores; neutral; clear wavy boundary.

A13-13 to 20 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; strong fine subangular blocky structure; very hard, very firm, sticky and plastic; common roots; many fine pores; neutral; clear wavy boundary.

B21tg-20 to 28 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; few fine yellowish brown (10YR 5/6) moist mottles; strong subangular blocky structure; very hard, very firm, sticky and plastic; few roots; many fine pores; few thin clay films on peds and in pores; neutral; gradual wavy boundary.

B22tg-28 to 41 inches gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; few fine yellowish brown (10YR 5/6) moist mottles; strong fine and medium prismatic structure; very hard, very firm, sticky and plastic; few roots; many fine pores; few thin clay films on peds and in pores; neutral; gradual wavy boundary.

Cg-41 to 60 inches; gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; massive; few fine dark brown (10YR 3/3) moist mottles; hard, firm, sticky and plastic; few roots; few fine pores; few thin clay films in pores; neutral.

The A horizon has value of 3 or 4 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. It is silt loam or silty clay loam. The B horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. It is silty clay loam, clay loam, or silty clay. The C horizon has value of 5 or 6 when dry and 3 or 4 when moist. It is silt loam, silty clay loam, or clay loam.

43-Konert silty clay loam. This nearly level soil is on bottom lands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have a silt loam surface layer and soils that are silt loam to a depth of 60 inches.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 1 1/2 to 2 1/2 feet.

This soil is used mainly for wheat, barley, legumes, grass, range, and wildlife habitat. Capability unit IVw-1: Wet Meadow range site.

44 Konert silt loam. This nearly level soil is on alluvial fans and bottom lands. It has a profile similar to the one described as representative of the series, but the upper 12 to 24 inches is recently deposited silt loam alluvium.

Included with this soil in mapping are soils that have a silty clay loam surface layer and soils that are silt loam to a depth of 60 inches.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 2 to 3 feet.

This soil is used mainly for wheat, barley, legumes, grass, range, and wildlife habitat. Capability unit IIIw-1; Wet Meadow range site.

Kuhl Series

The Kuhl series consists of gently sloping to very steep, well drained, cobbly soils underlain by basalt at a depth of 10 to 20 inches. The soils formed in loess and some volcanic ash that contained alluvium and residuum weathered from basalt. They are on side slopes of the Snake River and of drainageways and are in channeled scablands in the southern and western parts of the county. Elevation is 800 to 2,600 feet. The native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The annual precipitation is 12 to 15 inches. The frost-free season is 140 to 150 days.

In a representative profile the surface layer is dark grayish brown cobbly silt loam and grayish brown gravelly silt loam about 10 inches thick. The subsoil, to a depth of 16 inches, is yellowish brown gravelly silt loam underlain by basalt.

Kuhl soils have moderate permeability. The available water capacity is low. Roots penetrate to bedrock. Kuhl soils are used mainly for range and for wildlife habitat. They are mapped only in complex with Alpowa, Anders, and Asotin soils.

Representative profile of Kuhl cobbly silt loam in an area of Kuhl-Alpowa complex, 30 to 65 percent slopes, in an area of grassland, 2,400 feet west and 1,900 feet south of the northeast corner of sec. 11, T. 14 N., R. 40 E.:

- A11-0 to 6 inches; dark grayish brown (10YR 4/2) cobbly silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure ; slightly hard, friable, slightly sticky and slightly plastic; many roots; 15 percent angular basalt fragments; neutral; abrupt wavy boundary.
- A12-6 to 10 inches; grayish brown (10YR 5/2) gravelly silt loam, very dark grayish brown (10YR 3/2) moist; weak blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine tubular pores; 15 percent angular basalt fragments ; neutral.
- B2-10 to 16 inches; yellowish brown (10YR 5/4) gravelly silt loam, dark yellowish brown (10YR 3/4) moist; moderate medium subangular blocky structure ; slightly hard, friable, sticky and plastic; common fine and very fine roots; many very fine tubular pores; 25 percent angular basalt fragments; neutral.
- R-16 inches ; basalt.

Basalt is at a depth of 10 to 20 inches. The control section, between a depth of 10 inches and bedrock, is 15 to 35 percent gravel, cobbles, or stones. The profile is neutral to mildly alkaline, and in places there are lime accumulations on the basalt.

The A horizon has value of 4 or 5 when dry and 2 or 3 moist. It is cobbly loam or cobbly silt loam. The B2 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 loam or silt loam and is gravelly.

45-Kuhl-Alpowa complex, 30 to 65 percent slopes. These steep and very steep soils are on side slopes. This

complex consists of 50 percent Kuhl cobbly silt loam and 30 percent Alpowa cobbly silt loam. The Alpowa soil is on north-facing side slopes, and the Kuhl soil is on south-facing side slopes. The Kuhl soil has the profile described as representative for its series, and the Alpowa has one similar to the one described as representative for its series.

Included with these soils in mapping are areas of soils that are less than 10 inches or more than 20 inches deep over basalt, stony or very stony soils, and Rock outcrop. Included areas make up about 20 percent of the mapped acreage.

Runoff is rapid or very rapid, and the erosion hazard is high or very high.

These soils are used mainly for range and for wildlife habitat. Capability unit VIIs-1; Kuhl part in Shallow range site (S-2), Alpowa part in Loamy range site (L-2).

46-Kuhl-Anders complex, 3 to 15 percent slopes. These gently sloping to strongly sloping soils are in channeled scablands. This complex consists of 40 percent Kuhl cobbly silt loam that has slopes of 3 to 15 percent and 30 percent Anders silt loam, 3 to 15 percent slopes. The topography is mounded, and the mounds are 10 to 30 feet in diameter and are generally 10 to 30 feet apart. The tops of the mounds are generally 1 to 4 feet higher than the surrounding areas. The Anders soil is on the mounds, and the Kuhl soil is between the mounds.

Included with these soils in mapping are areas of soils that are less than 10 inches deep, silt loams that are 20 to 40 inches deep to gravel and cobbles, soils that are 40 to more than 60 inches deep, stony or very stony soils, silt loams, and Rock outcrop. Included areas make up about 30 percent of the mapped acreage.

Runoff is slow to medium, and the erosion hazard is slight or moderate. These soils are used mainly for range and for wildlife habitat. Capability unit VIIs-1; Kuhl part in Shallow range site (S-2), Anders part in Loamy range site (L-2).

47-Kuhl-Asotin complex, 7 to 30 percent slopes. These strongly sloping to moderately steep soils are on side slopes. This complex consists of 50 percent Kuhl cobbly silt loam that has slopes of 7 to 30 percent and 25 percent Asotin silt loam, 7 to 25 percent slopes. The tops of mounds are 1 to 4 feet higher than the surrounding areas, and the mounds are 6 to more than 12 feet in diameter and are generally 5 to 20 feet apart. The stringers are about 1 to 4 feet high, are 6 to 25 feet wide, and are more than 100 feet long. The Kuhl soil is in the areas between the mounds and stringers. The Asotin soil is free of cobbles and is on mounds and stringers.

Included with these soils in mapping are areas of soils that are less than 10 inches deep to basalt; soils that are 40 to 60 inches deep to basalt and that are cobbly, stony, or very stony ; and Rock outcrop. Included areas make up about 25 percent of the mapped acreage.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used mainly for range and wildlife habitat. Capability unit VIIs-1; Kuhl part in Shallow

range site (S-2), Asotin part in Loamy range site (L-2).

Lance Series

The Lance series consists of gently sloping to steep, well drained, severely eroded soils that formed in calcareous loess. The soils are on south-facing side slopes and ridgetops on uplands in the central part of the county. Elevation is 1,600 to 2,600 feet. The native vegetation is mainly Idaho fescue and bluebunch wheatgrass. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 140 days.

In a representative profile the surface layer is about 13 inches thick. The upper part is about 8 inches of light brownish gray silt loam that is 10 percent white, lime-silica cemented fragments. The lower part is about 5 inches of brown silt loam that is 2 percent white, lime-silica cemented fragments. The underlying material, to a depth of 25 inches, is brown and pale brown silt loam that is 2 percent white, lime-silica cemented fragments. Below this, to a depth of 60 inches, it is pale brown and very pale brown silt loam that is 10 percent white, lime-silica cemented fragments and has white, lime-silica cemented lenses 1/16 to 1/8 inch thick.

Lance soils have moderately slow permeability. The available water capacity is moderately high. Root penetration is limited by the strongly cemented lenses, but a few roots penetrate to a depth of 60 inches or more. Lance soils are used mainly for grass, alfalfa, and range.

Representative profile of Lance silt loam, 5 to 25 percent slopes, in a cultivated area, 3,600 feet north and 500 feet west of the southeast corner of sec. 9, T. 19 N., R. 39 E.:

Ap-0 to 8 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots; 10 percent lime-silica cemented fragments; strongly effervescent; strongly alkaline; abrupt smooth boundary.

A3-8 to 13 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; 2 percent lime-silica cemented fragments; slightly effervescent; moderately alkaline; clear wavy boundary.

Clsica-13 to 19 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine tubular pores; 2 percent lime-silica cemented fragments; slightly effervescent; moderately alkaline; clear wavy boundary.

C2sica-19 to 25 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine and very fine pores; common lime-silica cemented nodules 1 inch in diameter; 2 percent lime-silica cemented fragments; lime in pores and as coatings on peds; strongly effervescent; moderately alkaline; clear wavy boundary.

C3sica-25 to 30 inches; very pale brown (10YR 7/3) weakly lime-cemented brittle silt loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few roots; many fine and very fine pores; 10 percent lime-silica cemented fragments; lenses of lime-silica cemented material 1/16 to 1/8 inch thick; lime coatings on peds and in pores; strongly effervescent; strongly alkaline; clear wavy boundary.

C4sica-30 to 42 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; hard, firm (brittle), slightly sticky and slightly plastic; few roots; many fine and very fine pores; 10 percent lime-silica cemented fragments; strongly effervescent; strongly alkaline; clear wavy boundary.

C5sica-42 to 52 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few roots; many fine and very fine pores; lenses of lime-silica cemented material 1/16 to 1/8 inch thick; 10 percent lime-silica cemented fragments; strongly effervescent; strongly alkaline; clear wavy boundary.

C6sica-52 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 roots; many fine and very fine pores; lime in pores and in root channels; strongly effervescent; strongly alkaline.

The profile is generally calcareous in all parts but in places is noncalcareous in the upper 7 inches. Lime-silica cemented fragments or discontinuous layers occur randomly throughout. The control section, between depths of 10 and 40 inches, is 20 to 27 percent clay. 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 C 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.

48-Lance silt loam, 5 to 25 percent slopes. This gently sloping to moderately steep, severely eroded soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that have lime below a depth of 20 inches and a silt loam that is 60 inches deep and does not contain lime.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, grass, and alfalfa. Capability unit VIe-2.

49-Lance silt loam, 25 to 40 percent slopes. This moderately steep and steep, severely eroded soil is on uplands. It has a profile similar to the one described as representative of the series, but there are more lime-silica cemented fragments in the surface layer.

Included with this soil in mapping are areas of soils that contain lime below a depth of 20 inches and a silt loam that is 60 inches deep and that does not contain lime.

Runoff is rapid, and the hazard of erosion is high. This soil is used mainly for wheat, grass, alfalfa, and range. Capability unit VIe-2; Loamy range site (L-3).

Larkin Series

The Larkin series consists of gently sloping to very steep, well drained soils that formed in loess. The soils are along the drainageway of the Palouse River and buttes on uplands in the eastern part of the county. Elevation is 1,800 to 3,000 feet. The native vegetation is mainly ponderosa pine, Douglas-fir, pinegrass, snowberry, and rose. The annual precipitation is 22 to 23 inches. The frost-free season is 100 to 120 days.

In a representative profile the surface layer is grayish brown and brown silt loam about 16 inches thick. The subsoil extends to a depth of 60 inches. It is brown and yellowish brown silt loam to a depth of 32 inches. Below this, it is pale brown silty clay loam and heavy silt loam.

Larkin soils have moderate or moderately slow permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Larkin soils are used mainly for wheat, barley, peas, lentils, grass, alfalfa, woodland, and wildlife habitat.

Representative profile of Larkin silt loam, 3 to 15 percent slopes, in an area of woodland, 1,600 feet east and 1,620 feet south of the west quarter-corner of sec. 21, T. 17 N., R. 45 E.

A11-0 to 4 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 roots; neutral; abrupt smooth boundary.

A12-4 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; neutral; clear smooth boundary.

A3-9 to 16 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; many roots; many fine pores; gray (10YR 7/2) coatings on ped faces; neutral; gradual wavy boundary.

B1t-16 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak very fine subangular blocky;

slightly hard, friable, slightly sticky and slightly plastic; many roots ; many fine pores; many thin clay films; gray (10YR 7/2) coatings on peds; neutral; clear irregular boundary.

B21t-21 to 32 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to weak fine angular blocky; hard, friable, sticky and plastic; common roots; many fine pores; continuous thin clay films on vertical ped faces; few faint gray (10YR 7/2) coatings on peds; mildly alkaline; clear irregular boundary.

B22t-32 to 42 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to angular blocky; hard, firm, sticky and plastic; common roots ; many fine pores; continuous thin clay films on peds ; few fine manganese concretions; some organic staining; mildly alkaline; clear irregular boundary.

B3t-42 to 60 inches ; pale brown (10YR 6/3) heavy silt loam, dark brown (10YR 4/3) moist; weak prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common roots ; many fine pores; continuous thin clay films on peds.

Depth to basalt bedrock ranges from 40 to more than 60 inches.

The A horizon is 11 to 20 inches thick. It has value of 4 or 5 when dry and 2 or 3 when 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 24 to 30 percent clay.

50-Larkin silt loam, 3 to 15 percent slopes. This gently sloping to strongly sloping soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have basalt bedrock below a depth of 40 inches and soils that have a surface layer more than 20 inches thick.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, alfalfa, woodland, and wildlife habitat. Capability unit IIIe-8.

51-Larkin silt loam, 15 to 25 percent slopes. This moderately steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are areas of soils that have a surface layer more than 20 inches thick and areas of soils with basalt bedrock at a depth of 40 inches.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, alfalfa, woodland, and wildlife habitat. Capability unit IVe-8.

52-Larkin silt loam, 25 to 40 percent slopes. This moderately steep and steep soil is on uplands. It has a

profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thinner.

Included with this soil in mapping are areas of soils with basalt bedrock at a depth of 40 inches and soils that have a surface layer more than 20 inches thick.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for alfalfa, grass, woodland, and wildlife habitat. Capability unit V Ie-3.

53-Larkin silt loam, 40 to 55 percent slopes. This steep and very steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thinner.

Included with this soil in mapping are areas of soils with basalt bedrock at a depth of 40 inches, small areas of soils that have a surface layer more than 20 inches thick, and areas of Rock outcrop.

Runoff is very rapid, and the erosion hazard is very high.

This soil is used mainly for woodland and for wildlife habitat. Capability unit VIe-3.

Latah Series

The Latah series consists of nearly level, somewhat poorly drained soils that formed in alluvium from loess and volcanic ash. The soils are on bottom lands in the northeastern part of the county. Elevation is 1,800 to 2,800 feet. The native vegetation is mainly tufted hair-grass, sedges, and willows. The annual precipitation is 18 to 25 inches. The frost-free season is 110 to 135 days.

In a representative profile the surface layer is dark grayish brown silt loam about 19 inches thick. The subsurface layer, to a depth of 30 inches, is light gray and light brownish gray silt loam. The subsoil, which extends to a depth of 60 inches, is brown silty clay loam (fig. 16).

Latah soils have moderate permeability to a depth of 30 inches and very slow permeability at a depth of more than 30 inches. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Latah soils are used mainly for wheat, barley, oats, legumes, grass, range, and wildlife habitat.

Representative profile of Latah silt loam, in an area of grassland, 2,600 feet south and 600 feet west of the northeast corner of sec. 7, T. 15 N., R. 46 E.:

- A11-0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure ; slightly sticky and slightly plastic; many roots; many very fine pores; neutral ; abrupt smooth boundary.
- A12-6 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many very fine pores; neutral; clear wavy boundary.
- A13-10 to 19 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium prismatic structure; slightly hard, very

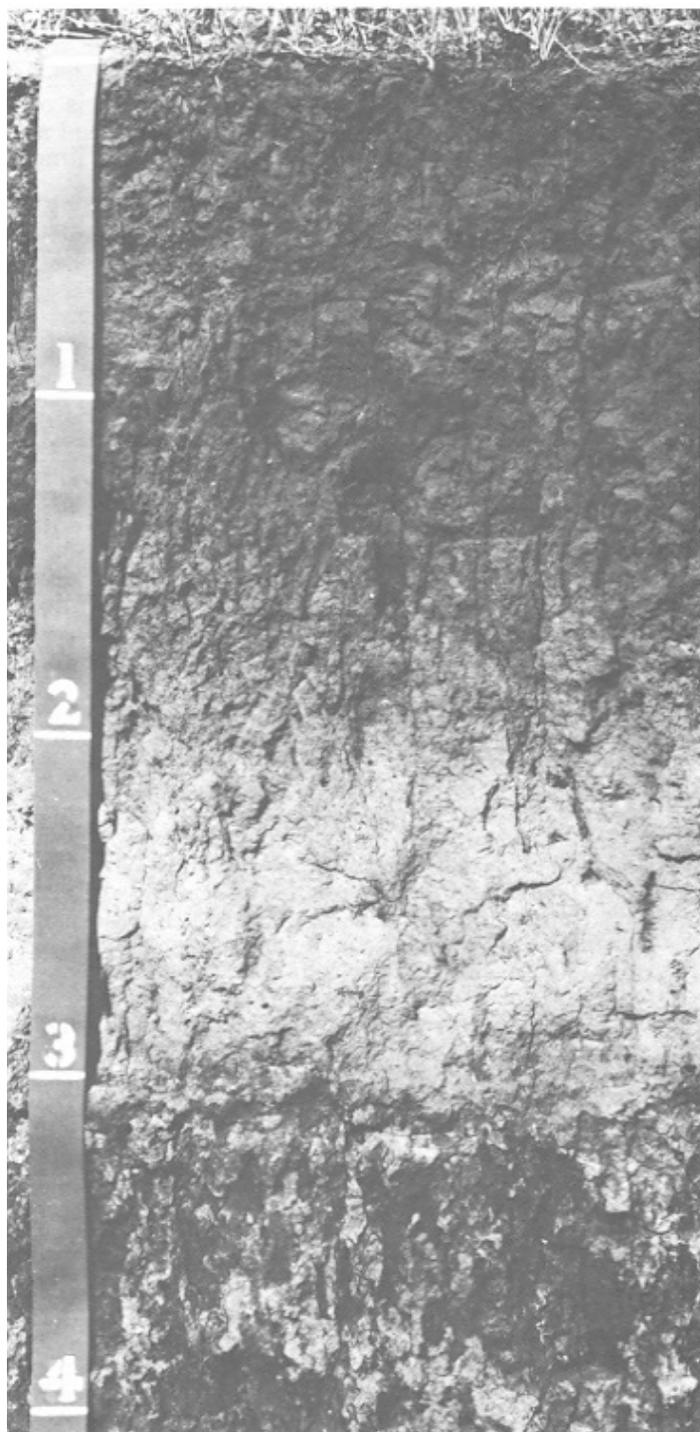


Figure 16.-Profile of Latah silt loam.

- friable, slightly sticky and slightly plastic; many roots; many very fine pores; neutral ; clear wavy boundary.
- A21-19 to 24 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine and medium prismatic structure; slightly hard, very

friable, slightly sticky and slightly plastic; common roots; common very fine pores; neutral; clear irregular boundary.

A22-24 to 30 inches; light gray (10YR 7/1) silt loam, gray (10YR 5/1) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common roots; many very fine pores; neutral; abrupt smooth boundary.

B21t-30 to 36 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; few fine and medium light brown (7.5YR 6/4) and light gray (2.5YR 7/2) mottles on peds; strong fine and medium subangular blocky structure; hard, very firm, sticky and plastic; some flattened roots between peds and no roots in peds; common very fine pores; thick continuous clay films on peds; organic matter stainings along vertical planes; neutral; clear smooth boundary.

B22t-36 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; common medium reddish yellow (7.5YR 6/6) and common medium and large light gray (2.5YR 7/2) mottles on peds; strong fine and medium subangular blocky structure; hard, very firm, sticky and plastic; some flattened roots between peds and no roots in peds; many very fine pores; thin continuous clay films on peds; organic matter stainings along fractures; neutral.

The profile is neutral to mildly alkaline throughout.

The thickness of the A1 horizon is 17 to 32 inches. The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. The A2 horizon has value of 5 to 7 when dry and 4 or 5 when moist, and it has chroma of 1 or 2 when dry or moist. The B horizon is silty clay loam, silty clay, or clay and is 35 to 60 percent clay. It 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. In places there are mottles below the All horizon. The A2 and B horizons have few very fine and fine manganese concretions in places.

54.--Latah silt loam. This nearly level soil is on bottom lands.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches, poorly drained soils, and soils that are silty clay loam to a depth of 60 inches.

Runoff is very slow, and there is little or no hazard of erosion. Low areas are subject to overflow. A seasonally high water table is at a depth of 1/2 foot to 2 1/2 feet.

This soil is used mainly for wheat, barley, oats, legumes, grass, range, and wildlife habitat. Capability unit IIIw-1; Wet Meadow range site.

Linville Series

The Linville series consists of steep to very steep, well drained soils that formed in loess and small amounts of volcanic ash and residuum from basalt.

The soils are in canyons along the drainageways of the Snake and Palouse Rivers in the southeastern part of the county. Elevation is 1,100 to 2,600 feet. The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, hawthorne, rose, and snowberry. The annual precipitation is 15 to 20 inches. The frost-free season is 110 to 120 days.

In a representative profile the surface layer is about 21 inches thick. It is dark grayish brown and grayish brown silt loam with a few pebbles and cobbles throughout. The subsoil, to a depth of 60 inches, is brown and yellowish brown cobbly silt loam. The content of pebbles and cobbles increases with depth.

Linville soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 40 to 60 inches or more. Linville soils are used mainly for range and for wildlife habitat.

Representative profile of Linville silt loam, 30 to 65 percent slopes, in an area of grassland, 1,800 feet east and 1,200 feet south of the northwest corner of sec. 17, T. 13 N., R. 44 E.:

All-0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common very fine pores; few basalt pebbles and cobbles; neutral; clear wavy boundary.

A12-4 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common very fine pores; few basalt pebbles and cobbles; neutral; clear wavy boundary.

A3-12 to 21 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common very fine pores; 5 percent basalt pebbles and cobbles; neutral; clear wavy boundary.

B21-21 to 29 inches; brown (10YR 5/3) cobbly silt loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many roots; common very fine pores; 25 percent basalt pebbles and cobbles; neutral; abrupt wavy boundary.

B22-29 to 36 inches; yellowish brown (10YR 5/4) cobbly silt loam; dark yellowish brown (10YR 3/4) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common roots; common very fine pores; few thin patchy clay films on peds; 25 percent basalt pebbles and cobbles; neutral; clear wavy boundary.

B3-36 to 60 inches; yellowish brown (10YR 5/4) cobbly silt loam, brown (10YR 4/3)

moist; weak fine and medium subangular blocky structure; hard, firm, sticky and plastic; few roots; few very fine pores; thin patchy clay films and lime coatings on undersides of some gravel and cobbles; 35 percent basalt pebbles and cobbles; moderately alkaline.

Depth to bedrock is 40 to 60 inches or more. The profile is neutral to moderately alkaline throughout.

Thickness of the A horizon is 20 to 30 inches. The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. It is 5 to 35 percent angular gravel or cobbles. The B horizon has value of 3 or 4 when moist and 5 or 6 when dry. It is 15 to 35 percent angular basalt pebbles and cobbles.

55-Linville silt loam, 30 to 65 percent slopes. This steep to very steep soil is on north-facing sides of canyons.

Included with this soil in mapping are areas of soils that have basalt at a depth of less than 40 inches, cobbly and stony soils, and Rock outcrop.

Runoff is rapid to very rapid, and the erosion hazard is high to very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIIe-1; North exposure range site (N-2).

Lithic Xerorthents

Lithic Xerorthents are nearly level to moderately steep, shallow and very shallow, well drained soils underlain by basalt. They formed in material weathered from basalt and loess. The soils are on basalt plateaus, on plateau breaks, and in channeled scablands. Elevation is 600 to 2,600 feet. The native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The annual precipitation is 12 to 18 inches. The frost-free season is 100 to 150 days.

In most places the soil is gravelly, very gravelly, or cobbly sandy loam, loam, or silt loam. Depth to basalt is 5 to 12 inches.

Lithic Xerorthents have moderate permeability. The available water capacity is low. Roots penetrate to bedrock. Lithic Xerorthents are used mainly for wildlife habitat and for limited grazing early in spring. They are mapped only in complex with Rock outcrop.

Magallon Series

The Magallon series consists of gently sloping to steep, somewhat excessively drained soils underlain by loose, coarse and very coarse basalt sand at a depth of 20 to 40 inches. The soils formed in glacial outwash derived from reworked loess, basalt, and some volcanic ash. They are on terraces of channeled scablands and along major drainageways in the southwestern part of the county. Elevation is 500 to 1,500 feet. The native vegetation is mainly bluebunch wheatgrass, Thurber needlegrass, and Sandberg wheatgrass. The annual precipitation is 11 to 12 inches. The frost-free season is 145 to 155 days.

In a representative profile the surface layer is grayish brown loam about 6 inches thick. The subsoil, to a depth of 12 inches, is brown fine sandy loam. The

stratum, to a depth of 28 inches, is brown sandy loam. Below this, to a depth of 60 inches, it is loose, coarse and very coarse basalt sand.

Magallon soils have moderate and moderately rapid permeability to a depth of 20 to 40 inches and rapid permeability at a depth of more than 40 inches. The available water capacity is moderate to moderately high. Roots penetrate to a depth of 60 inches or more. Magallon soils are used mainly for wheat, range, and wildlife habitat.

Representative profile of Magallon loam, 3 to 20 percent slopes, in an area of grassland, 400 feet west and 2,400 feet north of the center of sec. 33, T. 13 N., R. 37 E.:

A1-0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many roots; many fine pores; mildly alkaline; clear smooth boundary.

B2-6 to 12 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; many fine pores; mildly alkaline; clear smooth boundary.

C1-12 to 28 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; many fine pores; moderately alkaline; abrupt smooth boundary.

IIC2-28 to 60 inches; coarse and very coarse basalt sand; strongly alkaline.

Depth to coarse and very coarse sand is 20 to 40 inches. The part of the control section above the sand averages less than 50 percent fine and coarse sand.

The A horizon is 6 to 9 inches thick and is sandy loam, loam, or silt loam. It has value of 4 or 5 when dry and 2 or 3 when moist. The B2 horizon has value of 4 or 5 when dry and 2 or 3 when moist. The C horizon has value of 5 or 6 when dry and 3 or 4 when moist.

56-Magallon loam, 3 to 20 percent slopes. This gently sloping to moderately steep soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils with a coarse sandy loam surface layer and silt loam underlain by sand, gravel, and cobbles at a depth of 20 to 40 inches.

Runoff is slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, range, and wildlife habitat. Capability unit IVE-7; Loamy range site (L-2).

57-Magallon sandy loam, 20 to 40 percent slopes. This strongly sloping to steep soil is on terraces. It has a profile similar to the one described as representative of the series, but the surface layer is sandy loam.

Included with this soil in mapping are areas of soils with a loam surface layer and silt loams underlain by loose sand, gravel, and cobbles at a depth of 20 to 40 inches.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1 ; Sandy Loam range site.

Mondovi Series

The Mondovi series consists of nearly level, well drained soils that formed in alluvium from loess and some volcanic ash. The soils are on bottom lands and alluvial fans in the central part of the county. Elevation is 1,600 to 2,500 feet. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and giant wildrye. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 140 days.

In a representative profile the soil is dark grayish brown silt loam to a depth of 60 inches.

Mondovi soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Mondovi soils are used mainly for wheat, barley, and wildlife habitat.

Representative profile of Mondovi silt loam, in a cultivated area, 2,500 feet north and 2,400 feet west of the southeast corner of sec. 5, T. 16 N., R. 42 E.:

- Ap-0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; mildly alkaline; abrupt smooth boundary.
- A11-10 to 33 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; very few fine tubular pores; mildly alkaline; abrupt smooth boundary.
- A12-33 to 60 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; mildly alkaline.

The control section, between depths of 10 and 40 inches, is less than 18 percent clay.

The A horizon has value of 4 when dry and 2 when moist and chroma of 1 or 2 when dry or moist. It is neutral to mildly alkaline.

58-Mondovi silt loam. This nearly level soil is on bottom lands and alluvial fans.

Included with this soil in mapping are areas of soils that have bedrock at a depth of 20 to 40 inches and soils that are moderately alkaline to a depth of 60 inches.

Runoff is very slow, and there is little or no hazard of erosion. In places this soil is subject to flooding during winter and spring.

This soil is used mainly for wheat, barley, and wildlife habitat. Capability unit IIc-1.

Naff Series

The Naff series consists of gently sloping to steep, well drained soils that formed in loess and some vol-

canic ash. The soils are on ridgetops and south-facing slopes on uplands in the northeastern part of the county. Elevation is 2,000 to 3,000 feet. The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, and snowberry. The annual precipitation is 18 to 23 inches. The frost-free season is 110 to 130 days.

In a representative profile the surface layer is dark grayish brown silt loam about 9 inches thick. The next layer, to a depth of 18 inches, is dark brown silty clay loam. The subsoil extends to a depth of 60 inches. It is yellowish brown silty clay loam to a depth of 47 inches. Below this, it is light yellowish brown silt loam.

Naff soils have moderately slow permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Naff soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa.

Representative profile of Naff silt loam, 7 to 25 percent slopes, in a cultivated area, in the NE1/4 of sec. 26, T. 16 N., R. 44 E., 300 feet northwest of County Road No. 500

- 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, slightly sticky and slightly plastic; many fine and very fine roots; slightly acid; abrupt smooth boundary.
- AB-9 to 18 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) crushed ped faces, very dark brown (10YR 2/2) moist; weak coarse prismatic structure; hard, friable, slightly sticky and plastic; many fine and very fine roots; common fine pores; neutral ; clear wavy boundary.
- B21t-18 to 33 inches; yellowish brown (10YR 5/4) silty clay loam, dark brown (10YR 4/3) moist; ped faces, dark brown (7.5YR 3/3) moist; moderate medium prismatic structure parting to strong fine angular blocky; very hard, very firm, sticky and plastic; common fine and very fine roots; many micropores and common very fine pores; thin continuous clay films on peds ; neutral ; gradual wavy boundary.
- B22t-33 to 47 inches; yellowish brown (10YR 5/4) silty clay loam, dark brown (10YR 4/3) moist; ped faces, dark brown (7.5YR 3/3) ; moderate fine angular blocky structure; very hard, very firm, slightly sticky and plastic; few fine roots; many micropores and many fine pores; continuous thin clay films on peds; neutral; gradual wavy boundary.
- B3-47 to 60 inches; light yellowish brown (10YR 6/4) silt loam, dark yellowish brown (10YR 4/3) moist; weak prismatic structure parting to moderate fine angular blocky; hard, firm, slightly sticky and slightly plastic; few fine roots; common fine pores and many micro tubular pores; thin clay films on peds; few 2-millimeter iron-manganese concretions ; neutral.

The A horizon is 9 to 18 inches thick. It has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2. The AB horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. It is heavy silt loam or silty clay loam. The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It has continuous thin to thick clay films. The B3 horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 3 or 4. It is silt loam or silty clay loam and is slightly acid to mildly alkaline.

59-Naff silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on ridgetops and south-facing side slopes. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches, areas of soils that have a silty clay loam surface layer, and small areas of Naff soils that have slopes of less than 7 percent.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-5.

60-Naff silt loam, 25 to 40 percent slopes. This moderately steep to steep soil is on south-facing side slopes. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches and small areas of soils that have a silty clay loam surface layer.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVe-5.

61-Naff-Garfield complex, 3 to 25 percent slopes. These gently sloping to moderately steep soils are on ridgetops and south-facing slopes. This complex consists of 55 percent Naff silt loam, 7 to 25 percent slopes, and 35 percent Garfield silty clay loam, 3 to 25 percent slopes. The Garfield soil is on ridgetops and knobs, and the Naff soil is on south-facing slopes.

Included with these soils in mapping are areas of soils that are silt loam to a depth of 60 inches, small areas of soils that have an abrupt silty clay loam or silty clay layer at a depth of 20 to 40 inches, and areas of Naff and Garfield soils that have slopes of more than 25 percent.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

These soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVe-10.

Narcisse Series

The Narcisse series consists of nearly level, moderately well drained soils that formed in alluvium from loess, volcanic ash, and weathered metasediment and basalt. The soils are on bottom lands along drainageways of the Palouse River in the central and eastern part of the county. Elevation is 1,400 to 2,500 feet. The native vegetation is mainly ponderosa pine, hawthorne, giant wildrye, and other shrubs and grasses. The annual precipitation is 16 to 23 inches. The frost-free season is 100 to 135 days.

In a representative profile the surface layer is grayish brown silt loam and loam about 39 inches thick. The underlying material, to a depth of 52 inches, is light brownish gray fine sandy loam. Below this, to a depth of 60 inches, it is light brownish gray very fine sandy loam.

Narcisse soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Narcisse soils are used mainly for wheat, barley, oats, legumes, grass, woodland, and wildlife habitat.

Representative profile of Narcisse silt loam, in an area of grassland, 2,800 feet east and 1,400 feet north of the southwest corner of sec. 21, T. 17 N., R. 45 E.:

A11-0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; neutral; abrupt smooth boundary.

A12-5 to 19 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common fine pores; neutral; clear wavy boundary.

A13-19 to 39 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many roots; common fine and medium pores; u-inch sand lenses; neutral; clear wavy boundary.

C1-39 to 52 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine yellowish brown (10YR 5/6) mottles; massive; soft, very friable, nonsticky and nonplastic; many roots; common fine tubular pores; neutral; clear wavy boundary.

C2-52 to 60 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; many fine pores; neutral.

The control section, between depths of 10 and 40 inches, is loam, silt loam, fine sandy loam, sandy loam, or very fine sandy loam. Reaction is neutral to slightly acid.

Thickness of the A horizon is 20 to 40 inches or more. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. The C horizon has value of 6 or 7 when dry and 3 or 4 when moist, and it has chroma of 2 to 4 when *dry* or moist. It is loam, silt loam, sandy loam, very fine sandy loam, or fine sandy loam. A few 1/8- to 1/4-inch lenses of sand and gravel are in the C horizon.

62-Narcisse silt loam. This nearly level soil is on bottom lands.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches and soils that are 20 to 40 inches deep to basalt or gravel and cobbles.

Runoff is very slow, and there is little or no hazard

of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 3 to 5 feet.

This soil is used mainly for wheat, barley, oats, legumes, grass, woodland, and wildlife habitat. Capability unit IIIw-2.

Onyx Series

The Onyx series consists of nearly level, well drained soils that formed in alluvium from loess and some volcanic ash. The soils are on bottom lands along drainageways and alluvial fans in the southwestern part of the county. Elevation is 600 to 2,000 feet. The native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and giant wildrye. The annual precipitation is 12 to 15 inches. The frost-free season is 140 to 150 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 36 inches thick. The next layer, which extends to a depth of 60 inches, is brown silt loam.

Onyx soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Onyx soils are used mainly for wheat, barley, and wildlife habitat.

Representative profile of Onyx silt loam, in a cultivated area, 1,300 feet east and 100 feet north of the southwest corner of sec. 26, T. 15 N., R. 39 E.

Ap-0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; neutral; clear wavy boundary.

A12-10 to 21 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; many roots; many fine pores; neutral; abrupt smooth boundary.

A13-21 to 36 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; many roots; many fine pores; neutral; clear smooth boundary.

AC-36 to 60 inches ; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine pores; neutral.

The control section between depths of 10 and 40 inches is dominantly silt loam, but in many places there are lenses less than 1 inch thick of very fine sandy loam, fine sandy loam, sandy loam, or medium sand. It is also 12 to 18 percent clay. The profile is neutral to mildly alkaline throughout.

Thickness of the A horizon is 20 to 40 inches or more.

63-Onyx silt loam. This nearly level soil is on bottom lands.

Included with this soil in mapping are areas of soils that are more than 60 percent volcanic ash, soils that

are moderately alkaline to strongly alkaline in the surface layer, and soils that have lime in the subsoil.

Runoff is very slow, and there is little or no hazard of erosion. Areas of this soil are subject to flooding during winter and spring.

This soil is used mainly for wheat, barley, and wildlife habitat. Capability unit IIc-1.

Palouse Series

The Palouse series consists of gently sloping to very steep, well drained soils that formed in loess that contained some volcanic ash in the upper part. These soils are in the eastern part of the county. Elevation is 2,000 to 3,000 feet. The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, ninebark, and snowberry. The annual precipitation is 18 to 23 inches. The frost-free season is 110 to 130 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 24 inches thick. The subsoil is pale brown silt loam that extends to a depth of 60 inches.

Palouse soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Palouse soils are used mainly for wheat, barley, peas, lentils, grass, alfalfa, range, and wildlife habitat.

Representative profile of Palouse silt loam, 7 to 25 percent slopes, in a cultivated area, 280 feet north of a county road and 970 feet east of west boundary of sec. 27, T. 14 N., R. 45 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; neutral ; abrupt smooth boundary.

A12-7 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; clear wavy boundary.

A13-14 to 24 inches ; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine roots; many very fine pores; 20 percent of coarse pores and channels partially filled with dark colored material from the A1 horizon; neutral; gradual wavy boundary.

B21-24 to 40 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm, sticky and plastic; many fine roots ; many very fine pores; few thin clay films on peds ; 5 to 10 percent of area occupied by wormholes partially filled with dark colored material from the A horizon; neutral ; gradual wavy boundary.

B22-40 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate very fine subangular blocky; hard, firm, sticky and plastic; few fine roots; few fine pores, many very fine pores, and many micropores ; large wormholes about 5 inches apart; neutral.

The A horizon is 20 to 36 inches thick. It has value of 4 or 5 when dry and 2 or 3 when moist. It is medium acid to neutral. 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 silt loam or light silty clay loam and is slightly acid or neutral.

64-Palouse silt loam, 3 to 7 percent slopes. This gently sloping soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thicker.

Included with this soil in mapping are areas of soils that have a silt loam surface layer and slopes of more than 7 percent; areas of silty clay loams on knobs and ridges; and eroded spots, some of which are calcareous.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIe-3.

65-Palouse silt loam, 7 to 25 percent slopes. This strongly sloping and moderately steep soil is on uplands. The landscape is mainly smooth and rolling, and in places it is hilly. There are numerous ridges that have rounded tops and short side slopes. This soil has the profile described as representative of the series.

Included with this soil in mapping are spots of severely eroded soils that are calcareous; areas of soils that have a thin surface layer, on tops of ridges and knobs; areas on north-facing side slopes and concave areas of soils that have a surface layer more than 2 feet thick; areas of soils that have a subsoil of silty clay loam or calcareous silt loam; and areas less than 150 feet wide where the soils are steep and very steep.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-4.

66-Palouse silt loam, 7 to 25 percent slopes, eroded. This strongly sloping and moderately steep soil is mostly on convex, south-facing side slopes on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 6 to 8 inches thinner.

Included with this soil in mapping are spots, on ridgetops and knobs, of severely eroded soils that have a calcareous surface layer; areas of soils that have a surface layer of silty clay loam; concave areas of soils that have a surface layer more than 3 feet thick; areas of soils that have a subsoil of silty clay loam or silty clay; and areas of soils that have slopes of more than 25 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVe-10.

67-Palouse silt loam, 25 to 40 percent slopes. This moderately steep and steep soil is on uplands. The landscape is smooth and hilly and has numerous ridges and knobs. This soil has a profile similar to the one described

as representative of the series, but the surface layer is 2 to 4 inches thinner.

Included with this soil in mapping are spots of severely eroded soils that are calcareous; areas of soils that have a thin surface layer, on ridges and knobs ; concave areas and areas on north-facing side slopes of soils that have a surface layer 3 feet thick or more; areas of soils that have a surface layer or subsoil of silty clay loam; areas of soils that have a subsoil of calcareous silt loam; and areas of soils that have slopes of more than 40 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVe-4.

68-Palouse silt loam, 25 to 40 percent slopes, eroded. This moderately steep and steep soil is on smooth, south-facing side slopes and on a few ridges and knobs on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 6 to 7 inches thinner.

Included with this soil in mapping are areas of soils, on ridges and knobs, that have a calcareous surface layer ; areas of soils that have a silty clay loam surface layer; concave areas of soils that have a surface layer 2 feet thick or more; areas of soils that have a subsoil of silty clay loam or silty clay; and areas of soils that have slopes of more than 40 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit VIe-2.

69-Palouse silt loam, 40 to 55 percent slopes. This steep and very steep soil is on uplands. The landscape is smooth and hilly and has numerous ridges and rounded knobs. This soil has a profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thinner.

Included with this soil in mapping are spots of severely eroded soils that are calcareous; areas of soils that have a thin surface layer, on ridges and knobs ; and areas on north-facing side slopes and concave areas where the thickness of the surface layer is 3 feet or more. Also included are areas of soils that have a subsoil of silty clay loam or silty clay; narrow, very steep, semicircular areas, or eyebrows, of soils that have slopes of more than 55 percent; and areas of soils that have slopes of less than 40 percent.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1, North exposure range site (N-3).

70-Palouse-Thatuna silt loams, 3 to 7 percent slopes. These gently sloping soils are on uplands. This complex consists of 50 percent Palouse silt loam, 3 to 7 percent slopes, and 45 percent Thatuna silt loam, 3 to 7 percent slopes. The Palouse soil is in convex areas, and the Thatuna soil is in concave areas. The profiles of the Palouse and Thatuna soils are similar to the ones described as representative of their respective series, but the surface layer of the Palouse soil is 2 to 4 inches thicker and the surface layer of the Thatuna soil is 2 to 3 inches thicker.

Included with these soils in mapping are concave areas of soils that have a surface layer more than 40 inches thick and convex areas of soils that have a

subsoil of silty clay loam or silty clay. Included areas make up about 5 percent of the mapped acreage.

Runoff is slow, and the hazard of erosion is slight.

This complex is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIe-3.

71-Palouse-Thatuna silt loams, 7 to 25 percent slopes.

These strongly sloping and moderately steep soils are on north- and east-facing side slopes and on some south-facing foot slopes. This complex is 50 percent Palouse silt loam, 7 to 25 percent slopes, and 45 percent Thatuna silt loam, 7 to 25 percent slopes. These soils are mapped as a complex because they are so intermingled that it is not practical to show them separately on the map. The Palouse soil is in convex areas, and the Thatuna soil is in concave areas.

Included with these soils in mapping are convex areas of soils that are calcareous; areas of soils that have a thin surface layer, on tops of ridges or knobs; areas of soils that have a subsoil of silty clay loam or calcareous silt loam; areas of soils that have a surface layer and subsoil of silty clay loam; and areas less than 150 feet wide of steep and very steep soils. Included areas make up about 5 percent of the mapped acreage.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, peas, lentils, alfalfa, and grass. Capability unit IIIe-4.

72-Palouse-Thatuna silt loams, 25 to 40 percent slopes.

These moderately steep and steep soils are on north- and east-facing side slopes. This complex consists of 50 percent Palouse silt loam, 25 to 40 percent slopes, and 45 percent Thatuna silt loam, 25 to 40 percent slopes. These soils are mapped as a complex because they are so intermingled that it is not practical to show them separately on the map. The Palouse soil is in convex areas, and the Thatuna soil is in concave areas. The profiles of the Palouse and Thatuna soils are similar to the ones described as representative of their respective series, but the surface layer of the Palouse soil is 2 to 4 inches thinner and the surface layer of the Thatuna soil is 4 to 5 inches thicker.

Included with these soils in mapping are areas of calcareous soils that have a thin surface layer, on ridges and knobs; areas of soils that have a subsoil of silty clay loam; areas of soils that have a surface layer and subsoil of silty clay loam; and semicircular areas, or eyebrows, less than 1.50 feet wide of soils that have slopes of more than 40 percent. Included areas make up about 5 percent of the mapped acreage.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for wheat, barley, peas, lentils, alfalfa, and grass. Capability unit IVe-4.

73-Palouse-Thatuna silt loams, 40 to 55 percent slopes.

These steep to very steep soils are on north- and east-facing side slopes. This complex is 50 percent Palouse silt loam, 40 to 55 percent slopes, and 45 percent Thatuna silt loam, 40 to 55 percent slopes. These soils are mapped as a complex because they are so intermingled that it is not practical to show them separately on the map. The Palouse soil is in convex areas, and the Thatuna soil is in concave areas. The Palouse soil has a profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thinner.

Included with these soils in mapping are convex

areas of soils that have a surface layer and subsoil of silty clay loam; areas of soils that have a subsoil of silty clay loam or silty clay; areas of soils that have slopes of more than 55 percent; and areas of soils that have slopes of less than 40 percent.

Runoff is very rapid, and the hazard of erosion is very high.

These soils are used mainly for range and for wildlife habitat. Capability unit VIe-1; North exposure range site (N-3).

Pedigo Series

The Pedigo series consists of nearly level, somewhat poorly drained soils that formed in alluvium from loess and some volcanic ash. The soils are on wide bottom lands along drainage ways in the central part of the county. Elevation is 1,000 to 2,200 feet. The native vegetation is mainly giant wildrye and salt grass. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 155 days.

In a representative profile the surface layer is grayish brown, strongly alkaline silt loam about 36 inches thick. The underlying material, to a depth of 51 inches, is gray, strongly alkaline silt loam. Below this, to a depth of 60 inches, it is gray, moderately alkaline silt loam.

Pedigo soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Pedigo soils are used mainly for wheat, barley, legumes, grass, range, and wildlife habitat.

Representative profile of Pedigo silt loam, in an area of grass, 800 feet south and 1,500 feet east of the northwest corner of sec. 35, T. 17 N., R. 41 E.:

Ap-0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; slightly effervescent; strongly alkaline; abrupt smooth boundary.

A12-7 to 24 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; strongly effervescent; strongly alkaline; clear wavy boundary.

A13-24 to 36 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine pores; strongly effervescent; strongly alkaline; clear wavy boundary.

C1-36 to 51 inches; gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few roots; slightly effervescent; strongly alkaline; clear wavy boundary.

C2-51 to 60 inches; gray (10YR 6/1) silt loam,

dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; slightly effervescent; moderately alkaline.

The control section, between depths of 10 and 40 inches, is 10 to 18 percent clay. Reaction is strongly alkaline in the A horizon and very strongly alkaline to mildly alkaline in the C horizon. Salinity is slight.

Thickness of the A horizon is 24 to 40 inches. The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when dry or moist. The C horizon has hue of 10YR to 2.5Y, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 1 to 3. In places, there is a cemented hardpan at a depth of 40 to 60 inches.

74-Pedigo silt loam. This nearly level soil is on bottom lands along drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas of poorly drained soils, areas of soils that have a weakly cemented layer at a depth of 40 inches, areas of soils that are moderately alkaline, and spots of saline-alkali soils.

Runoff is very slow, and there is little or no hazard of erosion. This soil is subject to flooding during winter and spring. A seasonally high water table is at a depth of 2 1/2 to 5 feet.

This soil is used mainly for wheat, barley, legumes, grass, range, and wildlife habitat. Capability unit IIw-1; Alkali range site.

75-Pedigo silt loam, hardpan substratum. This nearly level soil is on bottom lands along drainageways. It has a profile similar to the one described as representative of the series, but there is a cemented hardpan at a depth of 40 to 60 inches and the soil is very strongly alkaline.

Included with this soil in mapping are areas of poorly drained soils, areas of soils that do not have a cemented hardpan, and areas of moderately alkaline soils.

Runoff is very slow, and there is little or no hazard of erosion. This soil has very slow permeability. It is subject to flooding during winter and spring. A seasonally high water table is at a depth of 2 1/2 to 5 feet.

This soil is used mainly for grass, range, and wildlife habitat. Capability unit VIw-1; Alkali range site.

Reardan Series

The Reardan series consists of gently sloping to strongly sloping, well drained soils that formed in layered loess and some volcanic ash. The soils are on foot slopes and terraces in the northwestern part of the county. Elevation is about 1,800 to 2,300 feet. The native vegetation is mainly Idaho fescue and bluebunch wheatgrass. The annual precipitation is 15 to 18 inches. The frost-free season is 100 to 130 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 13 inches thick. Beneath this is a 2-inch-thick layer of light grayish brown silt loam. The upper part of the subsoil, to a depth of 23 inches, is brown silty clay loam. The lower part, to a depth of 28 inches, is pale brown,

calcareous silt loam. The substratum, to a depth of about 60 inches, is light yellowish brown, calcareous silt loam.

Reardan soils have moderate permeability to a depth of 15 inches and slow permeability at a depth of more than 15 inches. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Reardan soils are used mainly for wheat, barley, and peas.

Representative profile of Reardan silt loam, 3 to 15 percent slopes, in a cultivated area, 1,600 feet south and 2,745 feet east of the northwest corner of sec. 11, T. 19 N., R. 40 E.:

- Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; few fine pores; neutral; abrupt smooth boundary.
- A1-8 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine and medium pores; neutral; clear wavy boundary.
- B&A-13 to 15 inches; light grayish brown (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine and medium pores; neutral; abrupt wavy boundary.
- B21t-15 to 19 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; strong fine and medium prismatic structure; very hard, very firm, sticky and plastic; common roots; many very fine and common fine roots; many fine and medium pores; many thin clay films and black (10YR 2/1) stains on prisms; moderately alkaline; clear wavy boundary.
- B22t-19 to 23 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate subangular blocky; very hard, very firm, sticky and plastic; few roots; common fine and medium pores; many thin clay films on peds and in pores; moderately alkaline; clear wavy boundary.
- B3ca-23 to 28 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; strong fine and medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, slightly sticky and slightly plastic; few roots; many fine and medium pores; slightly effervescent; moderately alkaline; clear wavy boundary.
- Cca-28 to 60 inches; light yellowish brown (10YR 6/4) silt loam, dark yellowish

brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; many fine and medium pores; most pores coated with lime; slightly effervescent; strongly alkaline.

Depth to bedrock is 40 to more than 60 inches; depth to lime is 20 to 35 inches.

Thickness of the A horizon is 10 to 18 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. The B&A horizon is 2 to 4 inches thick. The B2t horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3. It is silty clay loam to silty clay. Reaction is slightly alkaline to moderately alkaline. The B3ca and Cca horizons have value of 5 or 6 when dry and 3 or 4 when moist. They are silt loam to silty clay loam.

76-Reardan silt loam, 3 to 15 percent slopes. This gently sloping to strongly sloping soil is on foot slopes and terraces.

Included with this soil in mapping are areas of soils that have a surface layer more than 20 inches thick; spots of severely eroded soils, some of which are calcareous; areas of soils that have a silty clay loam surface layer; areas of soils that are silt loam to a depth of 60 inches; and areas of soils that are 20 to 40 inches deep to basalt or to loose sand, gravel, and cobbles.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used mainly for wheat, barley, and peas. Capability unit IIIe-3.

Risbeck Series

The Risbeck series consists of moderately steep and steep, well drained soils that formed in calcareous loess and some volcanic ash. The soils are on narrow ridgetops, knobs, and south-facing side slopes on undulating to hilly uplands in the western part of the county. Elevation is 1,200 to 2,200 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 130 to 155 days.

In a representative profile the surface layer is pale brown calcareous silt loam about 8 inches thick. The underlying material, to a depth of 60 inches, is pale brown, very pale brown, and light gray, calcareous silt loam. There are lime-silica cemented fragments throughout the soil. Lime-silica cemented lenses, 1/16 to 1 inch thick, occurs in some places.

Risbeck soils have moderate or moderately slow permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Risbeck soils are used mainly for wheat, alfalfa, grass, and range.

Representative profile of Risbeck silt loam, 15 to 40 percent slopes, in a cultivated area, 1,800 feet west and 2,400 feet north of the southeast corner of sec. 18, T. 15 N., R. 40 E.

Ap-0 to 8 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular

structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; 5 percent lime-silica cemented fragments; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1ca-8 to 19 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; hard, firm, slightly sticky and slightly plastic; many roots; few very fine and fine pores; lime occurs in pores and in root channels; 5 percent lime-silica cemented fragments; strongly effervescent; moderately alkaline; clear wavy boundary.

C2casi-19 to 32 inches; very pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; very hard, very firm, slightly sticky and slightly plastic; few roots; few very fine and fine pores; lime occurs in pores and in root channels; 10 percent lime-silica cemented fragments; violently effervescent; moderately alkaline; clear wavy boundary.

C3casi-32 to 43 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; very hard, very firm, slightly sticky and slightly plastic; few roots; few very fine and fine pores; 15 percent lime-silica cemented fragments; lime occurs in pores and in root channels; violently effervescent; strongly alkaline; clear wavy boundary.

C4ca-43 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; very hard, firm, slightly sticky and slightly plastic; few roots; few very fine and fine pores; intermittent weakly to strongly lime-silica cemented lenses 1/16 to 1 inch thick; 15 percent lime-silica cemented fragments; slightly effervescent; moderately alkaline.

Lime-silica cemented fragments make up 5 to 35 percent of the profile. Lime-silica cemented lenses are in places, and thickness varies from 1/16 to 1 inch. Depth to secondary carbonates is 0 to 10 inches.

The Ap horizon has value of 6 or 7 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when dry or moist. The Cca or Ccasi horizons have value of 6 or 7 when dry and 3 to 5 when moist, and they have chroma of 1 to 3. Reaction is moderately alkaline to strongly alkaline.

77-Risbeck silt loam, 15 to 40 percent slopes. This moderately steep and steep soil is on narrow ridgetops, knobs, and south-facing side slopes. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that are not calcareous in the surface layer and concave areas of soils that are not calcareous in the surface layer and subsoil.

Runoff is medium to rapid, and the erosion hazard is moderate or high.

This soil is used mainly for wheat, alfalfa, grass, and range. Capability unit VIe-2; Loamy range site (L-2).

Ritzville Series

The Ritzville series consists of gently sloping to very steep, well drained soils that formed in loess and some volcanic ash. The soils are on rolling to hilly uplands in the southwestern part of the county. Elevation is 1,000 to 2,000 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 11 to 12 inches. The frost-free season is 140 to 155 days.

In a representative profile the surface layer is grayish brown silt loam about 11 inches thick. The subsoil, to a depth of 38 inches, is brown silt loam. The substratum, to a depth of 60 inches, is pale brown and light gray calcareous silt loam.

Ritzville soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Ritzville soils are used mainly for wheat, grass, alfalfa, range, and wildlife habitat.

Representative profile of Ritzville silt loam, 3 to 30 percent slopes, in a cultivated area, 700 feet west and 1,140 feet south of the north quarter-corner of sec. 25, T. 13 N., R. 37 E.

Ap1-0 to 6 inches; -ravish brown (10YR 5/2) silt loam, dark brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; mildly alkaline; abrupt smooth boundary.

Ap2-6 to 11 inches; grayish brown (10Y R 5/2) silt loam, dark brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; many roots; few fine tubular pores; mildly alkaline; abrupt smooth boundary.

B2-11 to 27 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine tubular pores; mildly alkaline; gradual wavy boundary.

B3-27 to 38 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots ; many fine pores; mildly alkaline; gradual wavy boundary.

C1ca-38 to 43 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots ; many fine pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C2ca-43 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; strongly effervescent; strongly alkaline.

Depth to secondary carbonates is 30 to 43 inches.

Thickness of the A horizon is 8 to 14 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. 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. Reaction is neutral or mildly alkaline in the A and B horizons. The Cca horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3. It is moderately alkaline or strongly alkaline.

78-Ritzville silt loam, 3 to 30 percent slopes. This gently sloping to moderately steep soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have a lime-silica cemented hardpan or basalt bedrock at a depth of 20 to 40 inches ; areas of soils in which depth to lime is more than 43 inches; spots of severely- eroded soils, some of which are calcareous ; and areas of soils that have a thin surface layer, on narrow ridges and knobs.

Runoff is slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, grass, alfalfa, range, and wildlife habitat. Capability unit IIIe-1; Loamy range site (L-2).

79-Ritzville silt loam, 30 to 40 percent slopes. This steep soil is on uplands in the southwestern part of the county. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are areas of soils that have a lime-silica cemented hardpan or bedrock at a depth of 20 to 40 inches; areas of soils that have a high content of volcanic ash; areas of severely eroded, calcareous soils; areas of soils with a thin surface layer, on ridgetops and knobs; and areas of soils that have slopes of more than 40 percent.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for wheat, alfalfa, grass, wildlife habitat, and range. Capability unit IVe-1; Loamy range site (L-2).

80-Ritzville silt loam, 40 to 65 percent slopes. This steep to very steep soil is on uplands in the southwestern part of the county. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thinner.

Included with this soil in mapping are areas of soils that have a lime-silica cemented hardpan at a depth of 20 to 40 inches; areas of soils that have a high content of volcanic ash; areas of soils in which depth to lime is more than 43 inches; spots of severely eroded soils, some of which are calcareous; and areas on narrow ridges and knobs of soils that have a thin surface layer.

Runoff is very rapid, and the erosion hazard is very high.

The soil is used mainly for range and for wildlife habitat. Capability unit VIIe-1; North exposure range site (N-1).

Riverwash

81-Riverwash. These miscellaneous areas consist of deep, somewhat excessively drained and excessively drained soils that formed in alluvium. They are along streams, on islands, and on bars along the drainageways of the Palouse and Snake Rivers. The native

vegetation is sparse willow, shrubs, grass, and weeds. The mean annual precipitation is 11 to 18 inches. The frost-free season is 140 to 160 days.

These soils are generally very cobbly coarse sand underlain by stratified cobbles, boulders, gravel, and sand to a depth of 60 inches or more, but it is variable. Slopes are 0 to 7 percent. Riverwash is subject to flooding during spring.

These soils are used for wildlife habitat, for recreational areas, and for esthetic purposes. Capability unit VIII-w-1.

Rock Outcrop

82-Rock outcrop. These miscellaneous areas are nearly level to very steep and are in the channeled scablands and along the drainageways of Rock Creek and the Palouse and Snake Rivers. They consist mainly of exposed basalt. They are essentially barren or at most support a sparse stand of vegetation.

Areas more than 5 acres in size are delineated on the soil map, and smaller areas are shown by an escarpment symbol.

Included with Rock outcrop in mapping in some places are areas that have a very thin layer of soil material over bedrock.

This miscellaneous area is used for wildlife habitat, recreational areas, and esthetic purposes. Capability unit VIII-s-1.

83-Rock outcrop-Lithic Xerorthents complex, 0 to 30 percent slopes. These nearly level to moderately steep soils are in channeled scablands and along the drainageways of the Palouse and Snake Rivers and Rock Creek. Areas vary in size. This complex consists of 65 percent Rock outcrop and as much as 30 percent Lithic Xerorthents.

Included with this complex in mapping are small areas of gravelly and stony soils that are more than 12 inches deep. Included areas make up about 5 percent of the mapped acreage.

Runoff is slow to medium, and the erosion hazard is slight or moderate.

This complex is used mainly for wildlife habitat and for grazing to a limited extent in spring. Capability unit VIII-s-1.

Roloff Series

The Roloff series consists of nearly level to strongly sloping, well drained soils underlain by basalt bedrock at a depth of 20 to 40 inches. The soils formed in glacial outwash derived from basalt, loess, and some volcanic ash. They are on outwash terraces and uplands that border steep canyons along drainageways in the western part of the county. Elevation is 800 to 1,700 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 11 to 12 inches. The frost-free season is 135 to 155 days.

In a representative profile the surface layer is grayish brown silt loam about 11 inches thick. The subsoil, to a depth of 28 inches, is brown and pale brown silt loam underlain by basalt bedrock.

Roloff soils have moderate permeability. The available water capacity is moderate or moderately high.

Roots penetrate to bedrock. Roloff soils are used mainly for wheat, range, and wildlife habitat.

Representative profile of Roloff silt loam, 0 to 15 percent slopes, in an area of grassland, 700 feet east and 600 feet north of the west quarter-corner of sec. 17, T. 14 N., R. 37 E.:

A11-0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure parting to weak fine granular structure ; slightly hard, friable, slightly sticky and slightly plastic; many roots; neutral; abrupt smooth boundary.

A12-6 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine to medium tubular pores; neutral; clear smooth boundary.

B21-11 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; many roots; common very fine to medium tubular pores; mildly alkaline; clear smooth boundary.

B22-19 to 28 inches; pale brown (10YR 6/3) silt loam, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine to medium tubular pores; 5 percent coarse fragments; mildly alkaline; clear smooth boundary.

IIR-28 inches; basalt, slightly fractured.

Depth to bedrock is 20 to 40 inches.

Thickness of the A horizon is 10 to 16 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when moist or dry. It is silt loam or cobbly silt loam. The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist. The lower part of the B horizon is 2 to 25 percent gravel-sized fragments.

84-Roloff silt loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on outwash terraces. It has the profile described as representative of the series.

Included with this Soil in mapping are areas of Rock outcrop, soils that are less than 20 inches or more than 40 inches deep to bedrock, and soils that have gravel and cobbles at a depth of 20 to 40 inches.

Runoff is very slow to medium, and the hazard of erosion is slight or moderate.

This soil is used mainly for wheat, range, and wild life habitat. Capability unit IVE-7; Loamy range site (L-2).

85-Roloff cobbly silt loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on outwash terraces. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly and the subsoil has more gravel and cobbles.

Included with this soil in mapping are areas of soils that are not cobbly, soils that have gravel and cobbles

at a depth of 20 to 40 inches, stony and very stony soils, soils that are less than 20 inches deep to bedrock, and Rock outcrop.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; Loamy range site (L-2).

86-Roloff-Starbuck complex, 0 to 30 percent slopes. These nearly level to moderately steep soils are on outwash terraces and upper edges of steep canyon sides along drainageways. This complex consists of 40 percent Roloff silt loam that has slopes of 0 to 30 percent, on mounds and fingers, and 30 percent Starbuck cobbly silt loam that has slopes of 0 to 30 percent. The mounds range from 10 to 30 feet in diameter, are generally 5 to 20 feet apart and are generally 1 to 4 feet high.

Included with these soils in mapping are areas of soils that are deeper than 40 inches to bedrock, areas of soils that are less than 10 inches deep to bedrock, areas of Rock outcrop, soils in small basins, areas of soils that have gravel and cobbles at a depth of 20 to 40 inches, areas of stony and very stony soils, and areas of soils that have a cobbly surface layer. Included areas make up about 30 percent of the mapped acreage.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

These soils are used mainly for range and for wildlife habitat. Capability unit VIe-1; Roloff part in Loamy range site (L-2), Starbuck part in Shallow range site (S-2).

Schumacher Series

The Schumacher series consists of gently sloping to steep, well drained soils underlain by metasedimentary rock at a depth of 40 to 60 inches. The soils formed in loess and some volcanic ash and weathered residuum from metasediment. They are on foot slopes of buttes in the eastern part of the county. Elevation is 2,200 to 3,600 feet. The native vegetation is mainly Idaho fescue, rough fescue, and bluebunch wheatgrass. The annual precipitation is 18 to 23 inches. The frost-free season is 100 to 130 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 19 inches thick. The subsoil, to a depth of 43 inches, is brown and dark brown silty clay loam underlain by metasediments. There are pebbles throughout the profile; the amount increases with depth.

Schumacher soils have moderately slow permeability. The available water capacity is high. Roots penetrate to the metasediment. Schumacher soils are used mainly for wheat, barley, peas, lentils, alfalfa, grass, range, and wildlife habitat.

Representative profile of Schumacher silt loam, 3 to 15 percent slopes, in a cultivated area, 1,500 feet south and 1,800 feet east of the northwest corner of sec. 19, T. 19 N., R. 44 E.

Ap-0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular struc-

ture ; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; neutral; abrupt smooth boundary.

A12-6 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many fine pores; neutral_ ; gradual wavy boundary.

A3-12 to 19 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine pores; 5 percent gravel; neutral; abrupt wavy boundary.

B21t-19 to 31 inches; dark brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 3/4) moist; strong fine and medium angular blocky structure; very hard, very firm, sticky and plastic; few roots; few medium pores; thick continuous clay films on peds ; 15 percent gravel ; neutral ; clear wavy boundary.

B22t-31 to 37 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; strong fine and medium blocky structure; very hard, very firm, sticky and plastic; few fine roots; few medium pores; thick continuous clay films on peds ; 10 percent gravel; neutral; clear wavy boundary.

B3-37 to 43 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; very few fine roots; many very fine pores; thin continuous clay films on peds ; 12 percent gravel; neutral.

R-43 inches; metasedimentary rock.

Depth to bedrock is 40 to 60 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. This horizon is 0 to 5 percent gravel. The B2t horizon has value of 4 to 6 when dry and 3 or 4 when moist, chroma of 3 or 4 when dry or moist, and hue of 7.5YR or 10YR. It is silty clay loam or heavy silt loam and is 2 to 15 percent gravel and has a few manganese shot in some pedons. The B3 horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 3 or 4. It is heavy silt loam or silty clay loam and is 12 to 30 percent gravel. It has gray silt and sand particles in some places on peds.

87-Schumacher silt loam, 3 to 15 percent slopes.

This gently sloping to strongly sloping soil is on foot slopes of buttes. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Rock outcrop, soils that are 20 to 40 inches deep to bedrock, soils that are deeper than 60 inches to bedrock, and soils in swales where the surface layer is thicker than 20 inches.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for wheat, barley, peas, lentils, alfalfa, and grass. Capability unit IIIe-8.

88-Schumacher silt loam, 15 to 25 percent slopes. This moderately steep soil is on foot slopes of buttes. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are areas of Rock outcrop, areas of soils that have a silty clay subsoil, spots of severely eroded soils on ridges and knobs, areas of soils that have bedrock at a depth of 20 to 40 inches, and areas on north-facing side slopes and in swales of soils that have a surface layer more than 20 inches deep and a subsoil of silt loam to a depth of 60 inches.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, peas, lentils, alfalfa, grass, range, and wildlife habitat. Capability unit IVe-8; Loamy range site (L-3).

89-Schumacher silt loam, 25 to 40 percent slopes. This moderately steep to steep soil is on foot slopes of buttes. It has a profile similar to the one described as representative of the series, but the surface layer is 3 to 5 inches thinner.

Included with this soil in mapping are small areas of Rock outcrop; areas of soils that are 20 to 40 inches deep to bedrock, areas of silt loams that are 60 inches deep, areas on north-facing slopes and in swales of soils that have a surface layer more than 2 feet thick, and spots of severely eroded soils on ridges and knobs.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; Loamy range site (L-3).

Snow Series

The Snow series consists of strongly sloping, well drained soils that formed in colluvium and alluvium from loess and some volcanic ash. The soils are on foot slopes and terraces in the eastern part of the county. Elevation is 1,800 to 2,300 feet. The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, and snowberry. The annual precipitation is 18 to 23 inches. The frost-free season is 115 to 125 days.

In a representative profile the surface layer is dark grayish brown silt loam about 33 inches thick. The next layer, to a depth of 60 inches, is grayish brown silt loam.

Snow soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Snow soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa.

Representative profile of Snow silt loam, 7 to 15 percent slopes, in a cultivated area, 1,400 feet north and 400 feet west of the southeast corner of sec. 20, T. 16N., R. 43 E.

Ap-0 to 4 inches; grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly

sticky and slightly plastic; many fine roots; common very fine and fine pores; neutral; abrupt smooth boundary.

A11-4 to 22 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common very fine and fine pores; neutral; clear wavy boundary.

A12-22 to 33 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common very fine and fine pores; neutral; clear wavy boundary.

AC-33 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 fine roots; common fine pores; mildly alkaline.

Thickness of the Ap and A1 horizons is 30 to 48 inches. The control section, between depths of 10 and 40 inches, is 18 to 22 percent clay.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when dry or moist. It is neutral to mildly alkaline. The AC horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when dry or moist. It is neutral to moderately alkaline.

90-Snow silt loam, 7 to 15 percent slopes. This strongly sloping soil is on foot slopes and terraces.

Included with this soil in mapping are spots of severely eroded soils and areas of soils that have a silty clay or silty clay loam subsoil.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-4.

Speigle Series

The Speigle series consists of well drained, gently sloping to very steep, very stony soils underlain by basalt at a depth of 40 to more than 60 inches. The soils formed in loess, volcanic ash, and weathered basalt residuum. They are on canyon walls along drainageways of the Palouse River and in the Rock Lake area. Elevation is 1,600 to 3,000 feet. The native vegetation is mainly ponderosa pine, pine grass, ninebark, and snowberry and some Douglas-fir. The annual precipitation is 16 to 23 inches. The frost-free season is 110 to 135 days.

In a representative profile the surface layer is dark grayish brown and grayish brown, very stony silt loam and cobbly silt loam about 32 inches thick. The subsoil, to a depth of 44 inches, is brown cobbly silt loam. The substratum, to a depth of 60 inches, is brown and very pale brown, very cobbly silt loam.

Speigle soils have moderate permeability. The available water capacity is moderately high. Roots penetrate to a depth of 40 to more than 60 inches.

Speigle soils are used mainly for woodland, woodland grazing, and wildlife habitat.

Representative profile of Speigle very stony loam, in an area of Speigle-Rock outcrop complex, 30 to 65 percent slopes, in an area of woodland, 2,400 feet west and 2,300 feet north of the southeast corner of sec. 12, T. 17 N., R. 44 E.

- O1-2 to 1 1/2 inches; recent deposition of pine needles, twigs, and organic debris.
- O2-1 1/2 inches to 0; decomposed organic matter.
- A11-6 to 3 inches; dark grayish brown (10YR 4/2) very stony silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine and fine pores; 25 percent angular basalt fragments larger than 2 millimeters; neutral; abrupt smooth boundary.
- A12-3 to 13 inches; dark grayish brown (10YR 4/2) cobbly silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine and fine pores; 35 percent angular basalt fragments larger than 2 millimeters; neutral; clear wavy boundary.
- A13-13 to 20 inches; grayish brown (10YR 5/2) cobbly silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine and fine pores; 40 percent angular basalt fragments larger than 2 millimeters; neutral; clear wavy boundary.
- A3-20 to 32 inches; grayish brown (10YR 5/2) cobbly silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many very fine and fine pores; 40 percent angular basalt fragments larger than 2 millimeters; neutral; clear wavy boundary.
- B2-32 to 44 inches; brown (10YR 5/3) cobbly silt loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many very fine and fine pores; 40 percent angular basalt fragments larger than 2 millimeters; ash layer 1 inch thick at a depth of 32 to 33 inches; neutral; clear wavy boundary.
- C1-44 to 51 inches; brown (10YR 5/3) very cobbly silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; many very fine and fine pores; 60 percent angular basalt fragments larger than 2 millimeters; charcoal layer

at a depth of 44 inches; neutral; clear wavy boundary.

C2-51 to 54 inches; very pale brown (10YR 7/4) very cobbly silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; many very fine and fine pores; 60 percent angular basalt fragments larger than 2 millimeters; fines on basalt gravel and cobbles; neutral; clear wavy boundary.

C3-54 to 60 inches; brown (10YR 5/3) very cobbly silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; many very fine and fine pores; 60 percent angular basalt fragments larger than 2 millimeters; fines on basalt gravel and cobbles; neutral.

Depth to bedrock is 40 to 60 inches or more.

Thickness of the A horizon is 20 to 35 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 when dry or moist. The B and C horizons have value of 5 to 7 when dry and 3 to 5 when moist, and they have chroma of 3 or 4 when dry or moist. The B and C horizons are 40 to 75 percent gravel, cobbles, and stones. Reaction is neutral to mildly alkaline.

The Speigle soils in this survey area have a thicker A horizon than that defined in the range for the series and some areas are shallower, 40 to 60 inches to basalt, but these differences do not alter their usefulness or behavior. The dark color of the A horizon is mostly a result of the dark colored basalt sand in the soil.

91-Speigle-Rock outcrop complex, 3 to 30 percent slopes. These gently sloping to moderately steep soils are on north- and south-facing side slopes. This complex consists of 70 percent Speigle very stony silt loam and 20 percent Rock outcrop. The Speigle soil has a profile similar to the one described as representative of the Speigle series, but the surface layer is 2 to 3 inches thicker. Rock outcrop is essentially barren.

Included with these soils in mapping are areas of soils that are nonstony and 60 inches deep and soils that have lenses and pockets of volcanic ash in the subsoil. Included areas make up about 10 percent of the mapped acreage.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

These soils are used mainly for woodland, woodland grazing, and wildlife habitat. Capability unit VIs-1.

92-Speigle-Rock outcrop complex, 30 to 65 percent slopes. These steep to very steep soils are on north-facing sides of canyons. This complex consists of 70 percent Speigle very stony silt loam and 20 percent Rock outcrop. The Speigle soil has the profile described as representative of the Speigle series. Rock outcrop is essentially barren.

Included with these soils in mapping are areas of stony or cobbly soils that are less than 20 inches deep and areas of silt loams that are more than 60 inches deep. Included areas make up about 10 percent of the mapped acreage.

Runoff is rapid to very rapid, and the erosion hazard is high or very high.

These soils are used mainly for woodland, woodland grazing, and wildlife habitat. Capability unit VIIIs-1.

Spofford Series

The Spofford series consists of nearly level to strongly sloping, moderately well drained soils that formed in loess and some volcanic ash underlain by basalt at a depth of 40 to 60 inches or more. The soils are on uplands that border canyon sides along drainageways in the central part of the county. Elevation is 1,800 to 2,600 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 14 to 18 inches. The frost-free season is 130 to 145 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 8 inches thick. The subsurface layer, to a depth of 12 inches, is light brownish gray silt loam. The upper part of the subsoil, to a depth of 16 inches, is brown, calcareous silty clay loam. The lower part, to a depth of 23 inches, is pale brown, calcareous silt loam. The substratum, to a depth of 60 inches, is pale brown and light gray, calcareous silt loam.

Spofford soils have slow permeability. The available water capacity is moderate to moderately high. Roots penetrate to a depth of 60 inches, but there are only few below a depth of 12 inches. Spofford soils are used mainly for wheat, barley, alfalfa, grass, range, and wildlife habitat.

Representative profile of Spofford silt loam, 0 to 15 percent slopes, in grass, 900 feet north and 20 feet west of the southeast corner of sec. 5, T. 17 N., R. 41 E.:

- A11-0 to 2 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; neutral; abrupt smooth boundary.
- A12-2 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderately thin and medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine and fine pores; mildly alkaline; clear wavy boundary.
- A2-8- to 12 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderately thin and medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common very fine and fine pores; moderately alkaline; abrupt wavy boundary.
- B21t-12 to 14 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; strong coarse and medium columnar structure parting to strong fine and medium prismatic; very hard, very firm, sticky and plastic; few roots; few very

fine and fine pores; thin continuous clay films on peds; few very dark brown (10YR 2/2) organic stains on peds; strongly alkaline; clear wavy boundary.

B22t-14 to 16 inches; brown (10YR 6/3) silty clay loam, dark brown (10YR 3/3) moist; strong fine and medium prismatic structure parting to strong fine subangular blocky; very hard, very firm, sticky and plastic; few roots; few very fine and fine pores; thin continuous clay films on peds; many very dark brown (10YR 2/2) organic stains on peds; slightly effervescent; strongly alkaline; clear wavy boundary.

B3ca-16 to 23 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few roots; many very fine and fine pores; lime in pores and root channels; slightly effervescent; strongly alkaline; clear wavy boundary.

C1ca-23 to 28 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few roots; many very fine and fine pores; lime in pores and root channels; strongly effervescent; strongly alkaline; clear wavy boundary.

C2ca-28 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; many fine and very fine pores; lime in pores and root channels; violently effervescent; strongly alkaline.

Bedrock is at a depth of 40 to 60 inches or more.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when dry or moist. The A2 horizon is 2 to 6 inches thick. It has a 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 B2t horizon is heavy silt loam to silty clay loam. It 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 moderately alkaline to strongly alkaline. The B3ca horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 3 or 4 when dry or moist. It is moderately alkaline to strongly alkaline. The Cca 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.

93-Spofford silt loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on uplands that border canyon sides along drainageways.

Included with this soil in mapping are areas of soils that are 20 to 40 inches deep to basalt bedrock and silt loams that are 60 inches deep.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, barley, alfalfa,

grass, range, and wildlife habitat. Capability unit IVe-11; Loamy range site (L-3).

Staley Series

The Staley series consists of strongly sloping to moderately steep, well drained soils that formed in loess and volcanic ash. The soils are on ridgetops, knobs, and south-facing side slopes on uplands in the northeastern part of the county. Elevation is 2,000 to 3,000 feet. The native vegetation is mainly Idaho fescue and bluebunch wheatgrass. The annual precipitation is 18 to 23 inches. The frost-free season is 110 to 130 days.

In a representative profile the surface layer is grayish brown silt loam about 18 inches thick. The subsoil and substratum, to a depth of 60 inches, are brown calcareous silt loam.

Staley soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Staley soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa.

Representative profile of Staley silt loam, 7 to 25 percent slopes, in a cultivated area, 1,140 feet south and 360 feet west of the northeast corner of sec. 27, T. 18 N., R. 43 E.

Ap-0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable; slightly sticky and slightly plastic; many roots; neutral; abrupt smooth boundary.

A3-7 to 18 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; mildly alkaline; clear wavy boundary.

B21ca-18 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine and medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common roots; common fine pores; lime in pores and root channels and on peds; slightly effervescent; moderately alkaline; clear wavy boundary.

B22ca-21 to 29 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common roots; common fine pores; lime in pores and root channels and on peds; slightly effervescent; moderately alkaline; clear wavy boundary.

B3ca-29 to 40 inches; brown (10YR 5/2) silt loam, dark brown (10YR 3/3) moist; weak fine and medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common roots; lime in pores and root channels and on peds; slightly effervescent; moderately alkaline; clear wavy boundary.

C1ca-40 to 54 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few roots; lime in pores and root channels; slightly effervescent; moderately alkaline; clear wavy boundary.

C2ca-54 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few roots; lime in pores and root channels; slightly effervescent; strongly alkaline.

The control section, between depths of 10 and 40 inches, is 18 to 23 percent clay. Depth to secondary carbonates is 15 to 24 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 is moderately alkaline or strongly alkaline.

94-Staley silt loam, 7 to 25 percent slopes. This strongly sloping to moderately sloping soil is on ridgetops, knobs, and south-facing side slopes on uplands.

Included with this soil in mapping are spots of severely eroded, calcareous soils, areas of soils in which the depth to lime is more than 40 inches, areas on top of ridges and knobs of soils that have a thin surface layer, areas in swales of soils that have a surface layer 2 feet or more thick, and areas of soils that have a silty clay loam subsoil.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVe-10.

Starbuck Series

The Starbuck series consists of well drained, cobbly soils underlain by basalt at a depth of 10 to 20 inches. The soils formed in loess and some volcanic ash and weathered residuum from basalt. They are steep and very steep in canyons along major drainageways and are nearly level to moderately steep in channeled scablands in the southwestern part of the county. Elevation is 600 to 3,000 feet. The native vegetation is mainly bluebunch wheatgrass and Sandberg wheatgrass. The annual precipitation is 11 to 12 inches. The frost-free season is 150 to 160 days.

In a representative profile the surface layer is about 9 inches thick. It is grayish brown cobbly silt loam in the upper 3 inches and brown gravelly silt loam in the lower 6 inches. The subsoil is pale brown gravelly loam which extends to bedrock at a depth of 15 inches.

Starbuck soils have moderate permeability. The available water capacity is low. Roots penetrate to bedrock, and some extend into fractures. Starbuck soils are used mainly for range and for wildlife habitat.

Representative profile of Starbuck cobbly silt loam, in an area of Starbuck-Alpowa complex, 30 to 65 percent slopes, in an area of grassland, 1,900 feet east and 1,300 feet south of the northwest corner of sec. 22, T. 13 N., R. 39 E.

A11-0 to 3 inches; grayish brown (10YR 5/2) cobbly silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular

structure ; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine and very fine tubular pores; 25 percent angular basalt fragments larger than 2 millimeters; mildly alkaline ; clear wavy boundary.

A12-3 to 9 inches; brown (10YR 5/3) gravelly silt loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable; slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; 35 percent angular basalt fragments larger than 2 millimeters; mildly alkaline; abrupt irregular boundary.

B2-9 to 15 inches; pale brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; 30 percent angular basalt fragments larger than 2 millimeters; neutral; abrupt wavy boundary.

R-15 inches; basalt.

Basalt is at depth of 10 to 20 inches. The control section, between a depth of 10 inches and bedrock, is 5 to 35 percent gravel, cobbles, and stones.

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 loam or silt loam and is cobbly and gravelly. 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 gravelly loam or gravelly silt loam.

95-Starbuck-Alpowa complex, 30 to 65 percent slopes. These steep and very steep soils are in canyons. This complex consists of 50 percent Starbuck cobbly silt loam and 25 percent Alpowa cobbly silt loam. The Starbuck soil has the profile described as representative of the Starbuck series. The Alpowa soil has a profile similar to the one described as representative of the Alpowa series, but it is more than 60 inches deep to basalt.

Included with these soils in mapping are areas of soils that have a very fine sandy loam surface layer, soils that are less than 10 inches deep to bedrock, Rock outcrop, soils that have a sandy loam surface layer and are 20 to 40 inches deep to loose coarse sand, and soils that have bedrock at a depth of 20 to 40 inches. Included areas make up about 25 percent of the mapped acreage.

Runoff is rapid to *very* rapid, and the erosion hazard is high or very high.

These soils are used mainly for range and for wildlife habitat. Capability unit VIIe-1; Starbuck part in Shallow range site (S-2), Alpowa part in North exposure range site (N-1).

Stratford Series

The Stratford series consists of nearly level to strongly sloping, well drained soils underlain by very gravelly coarse sand at a depth of 20 to 40 inches. The soils formed in gravelly alluvium derived partly from

loess and volcanic ash. They are on outwash terraces of channeled scablands in the southwestern part of the county. Elevation is 600 to 1,700 feet. The native vegetation is mainly bluebunch wheatgrass and Sandberg wheatgrass. The annual precipitation is 11 to 12 inches. The frost-free season is 140 to 160 days.

In a representative profile the surface layer is grayish brown loam about 8 inches thick. The subsoil, to a depth of 16 inches, is brown loam. The substratum, to a depth of 24 inches, is pale brown gravelly loam. Below this, to a depth of 60 inches, it is loose very gravelly coarse sand. The undersides of pebbles are coated with lime and silica. There is basaltic gravel throughout the profile, and the amount increases with depth.

Stratford soils have moderate permeability. The available water capacity is moderate or moderately high. Root penetration is somewhat limited by the very gravelly coarse sand at a depth of 20 to 40 inches. Stratford soils are used mainly for wheat, range, and wildlife habitat.

Representative profile of Stratford loam, 0 to 15 percent slopes, in an area of grassland, 900 feet West and 340 feet south of the east quarter-corner of sec. 36, T. 13 N., R. 37 E.:

A1-0 to 8 inches; grayish brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; mildly alkaline; clear smooth boundary.

B2-8 to 16 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine roots ; common fine pores; 10 percent fine gravel; mildly alkaline; clear wavy boundary.

C1-16 to 24 inches; pale brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; many fine roots; 50 percent gravel ; mildly alkaline; abrupt smooth boundary.

IIC2ca-24 to 60 inches; very gravelly coarse sand; pebbles have common lime-silica coatings on underside; slightly effervescent ; moderately alkaline.

Depth to the very gravelly coarse sand is 20 to 40 inches.

Thickness of the A horizon is 6 to 12 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. It is loam or very cobbly loam. 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. It is gravelly loam or gravelly silt loam. The C1 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4. It is gravelly loam or gravelly silt loam. In places it is calcareous in the lower part. The IIC2ca horizon is mildly alkaline or moderately alkaline.

96-Stratford loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on outwash terraces. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Rock

outcrop, soils that have basalt bedrock or basaltic sand at a depth of 20 to 40 inches, soils that have a sandy loam surface layer, and soils that have basalt at a depth of more than 40 inches.

Runoff is very slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for wheat, range, and wildlife habitat. Capability unit IVe-7 ; Loamy range site (L-2).

97-Stratford very cobbly loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on outwash plains and terraces. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner and it is very cobbly.

Included with this soil in mapping are areas of Rock outcrop, escarpments where slopes are more than 15 percent, soils that have basalt or basaltic sand at a depth of less than 10 inches, soils that have basalt bedrock at a depth of 20 to 40 inches, stony and very stony soils, and soils that are free of cobbles.

Runoff is very slow to medium, and the erosion hazard is slight to moderate. This soil is used mainly for range and for wildlife habitat. Capability unit VIIIs-1; Loamy range site (L-2).

Tekoa Series

The Tekoa series consists of gently sloping to very steep, well drained soils underlain by unconsolidated metasediment at a depth of 20 to 40 inches. The soils formed in loess, volcanic ash, and weathered metasediments. They are on buttes in the eastern part of the county. Elevation is 2,000 to 4,000 feet. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, rough fescue, and scattered ponderosa pine. The annual precipitation is 20 to 23 inches. The frost-free season is 100 to 130 days.

In a representative profile the surface layer is dark grayish brown and grayish brown gravelly silt loam about 7 inches thick. The subsoil, to a depth of 20 inches, is brown and pale brown gravelly loam. The substratum, to a depth of 40 inches, is yellow very gravelly loam. Below this, it is unconsolidated metasediment (fig. 17).

Tekoa soils have moderate permeability. The available water capacity is moderate or moderately high. Roots penetrate to the metasediment. Tekoa soils are used mainly for wheat, barley, peas, lentils, grass, range, woodland, and wildlife habitat.

Representative profile of Tekoa gravelly silt loam, 25 to 55 percent slopes, in an area of grassland, 1,700 feet west and 200 feet south of the northwest corner of sec. 2, T. 20 N., R. 45 E.:

A11-0 to 3 inches; dark grayish brown (10YR 4/2) gravelly silt loam, very dark brown (10YR 2/2) moist; weak thin and medium platy structure parting to moderate fine and medium granular; slightly hard, friable, slightly sticky and slightly plastic; many roots ; many very fine and fine pores; 35 percent gravel ; neutral ; clear wavy boundary.

A12-3 to 7 inches; grayish brown (10YR 5/2) gravelly silt loam, very dark grayish

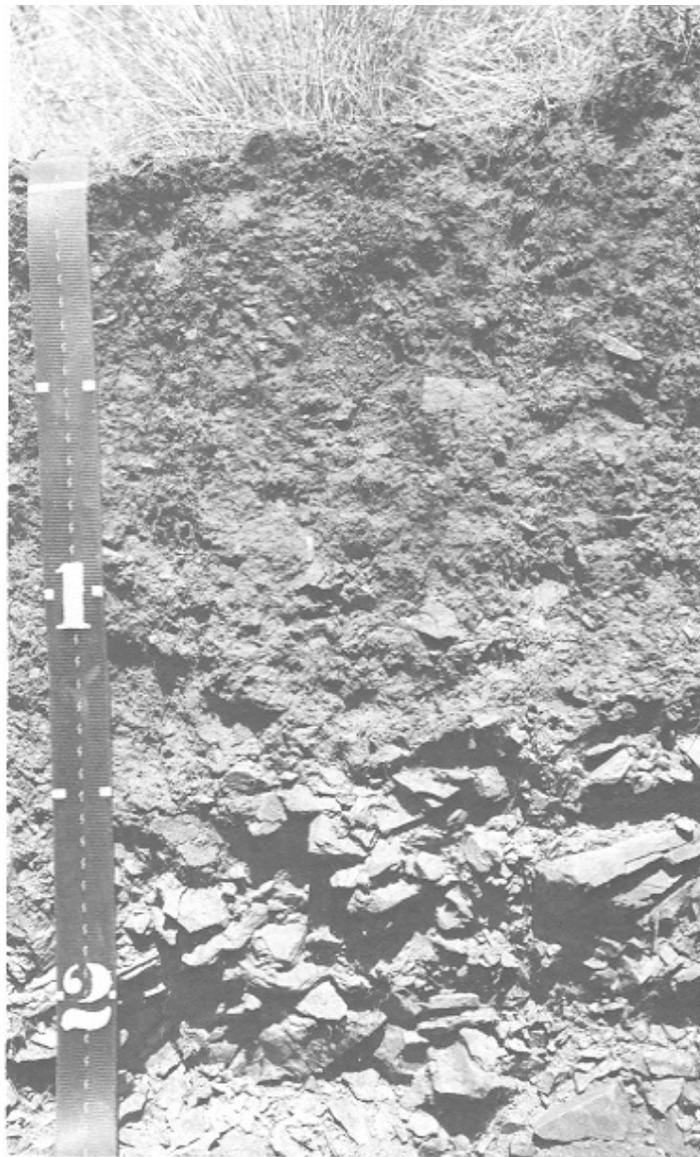


Figure 17.-Profile of Tekoa gravelly silt loam, 25 to 55 percent slopes, overlying unconsolidated metasediments.

brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots ; many very fine and fine pores; 35 percent gravel; slightly acid; clear wavy boundary.

B1-7 to 14 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure ; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine and fine pores; 35 percent gravel ; neutral; clear wavy boundary.

B2t-14 to 20 inches ; pale brown (10YR 6/3)

gravelly heavy loam, dark brown (10YR 4/3) moist; moderate fine and medium prismatic structure; slightly hard, friable, sticky and plastic; common roots; many fine and medium pores; many thin clay films on peds and in pores; 35 percent gravel ; neutral; clear wavy boundary.

C1-20 to 38 inches; yellow (10YR 7/6) very gravelly loam, yellowish brown (10YR 5/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; 60 percent gravel; neutral; clear wavy boundary.

Cr-38 inches; unconsolidated metasediments.

Depth to the unconsolidated metasediments is 20 to 40 inches. The control section, between a depth of 10 inches and weathered metasediment, is 35 to 60 percent coarse fragments. The profile has hue of 10YR or 7.5YR throughout.

Thickness of the A horizon is 6 to 9 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. Reaction is neutral or slightly acid. 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. It is silt loam or loam and is 35 to 60 percent coarse fragments. Reaction is neutral or slightly acid. The C horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 3 to 6. It is loam or silt loam and has 35 to 70 percent coarse fragments. Reaction is neutral or slightly acid.

In Tekoa gravelly silt loam, deep, 25 to 55 percent slopes, the A horizon is thicker and depth to unconsolidated metasediment is greater than is defined in the range for the series. These differences do not significantly affect use and management.

98-Tekoa silt loam, 3 to 25 percent slopes. This gently sloping to moderately steep soil is on foot slopes of buttes. It has a profile similar to the one described as representative of the series, but the surface layer is 3 to 4 inches thicker and has less gravel.

Included with this soil in mapping are areas of soils that have slopes of more than 25 percent, Rock outcrop, soils that are less than 20 inches deep to weathered metasediments, soils that are stony or cobbly, silt loams that are 40 to more than 60 inches deep to bedrock, and soils that have a silt loam surface layer and a silty clay subsoil.

Runoff is slow to medium, and the erosion hazard is slight to moderate. The available water capacity is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, range, and wildlife habitat. Capability unit IVE-8; Loamy range site (L-3).

99-Tekoa silt loam, 25 to 40 percent slopes. This moderately steep to steep soil is on buttes. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker and has less gravel.

Included with this soil in mapping are areas of Rock outcrop, soils that are less than 20 inches deep to bedrock, soils that are more than 40 inches deep to bedrock, stony or cobbly soils, and soils that have a silt loam surface layer and a silty clay loam subsoil.

Runoff is rapid, and the erosion hazard is high.

Available water capacity is moderate.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; Loamy range site (L-3)

100-Tekoa gravelly silt loam, 25 to 55 percent slopes. This moderately steep to very steep soil is on buttes. It has the profile described as representative of the series

Included with this soil in mapping are areas of Rock outcrop, soils that are less than 20 inches deep to bedrock, Tekoa soils that have slopes of less than 25 percent, soils that have a silt loam surface layer and a silty clay loam subsoil, stony or cobbly soils, and spots of severely eroded soils.

Runoff is rapid to very rapid, and the erosion hazard is high to very high. Available water capacity is moderate.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1 ; Loamy range site (L-3).

101-Tekoa gravelly silt loam, deep, 25 to 55 percent slopes. This moderately steep to very steep soil is on north- and east-facing sides of buttes. It has a profile similar to the one described as representative of the series, but the surface layer is 1 to 7 inches thicker and the depth to unconsolidated metasediments is 40 to 60 inches.

Included with this soil in mapping are areas of Rock outcrop, soils that are less than 40 inches deep to unconsolidated metasediments, silt loams that are 60 inches deep, and stony or cobbly soils.

Runoff is rapid to very rapid, and the erosion hazard is high or very high. The available water capacity is moderately high.

This soil is used mainly for woodland, woodland grazing, and wildlife habitat. Capability unit VIe-3.

102-Tekoa stony silt loam, 25 to 40 percent slopes. This moderately steep to steep soil is on buttes. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker and the surface is stony.

Included with this soil in mapping are areas of Rock outcrop, soils with no stones, cobbly soils; soils that have slopes less than 25 percent or more than 40 percent, and soils that have a silt loam surface layer and silty clay loam or silty clay subsoil to a depth of 60 inches.

Runoff is rapid, and the erosion hazard is high. Available water capacity is moderate.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; Loamy range site (L-3).

Thatuna Series

The Thatuna series consists of gently sloping to very steep, moderately well drained soils that formed in loess and volcanic ash. These soils are on north- and east-facing side slopes and south-facing foot slopes in the northeastern part of the county. Elevation is 2,000 to 3,000 feet. The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, ninebark, and snowberry. The annual precipitation is 18 to 23 inches. The frost-free season is 110 to 130 days.

In a representative profile the surface layer is dark grayish brown silt loam about 16 inches thick. The subsoil extends to a depth of 60 inches. It is brown silt loam to a depth of 33 inches and light brownish gray silt loam to a depth of 39 inches. Below this, it is pale brown and light yellowish brown silty clay loam.

Thatuna soils have moderate permeability above a depth of 39 inches and moderately slow permeability below a depth of 39 inches. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Thatuna soils are used mainly for wheat, barley, peas, lentils, grass, alfalfa, range, and wildlife habitat.

Representative profile of Thatuna silt loam, 7 to 25 percent slopes, in an area of grassland, 200 feet west and 2,640 feet south of the northeast corner of sec. 11, T. 19 N., R. 45 E.:

A11-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; neutral; abrupt smooth boundary.

A12-8 to 16 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; neutral; clear wavy boundary.

B21-16 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine and medium prismatic structure; hard, firm, sticky and plastic; many fine and very fine roots; many fine and very fine pores; 5 to 10 percent wormholes partially filled with dark material from the A horizon; neutral; clear wavy boundary.

B22-21 to 33 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; medium moderate prismatic structure parting to fine and medium subangular blocky; hard, firm, sticky and plastic; many fine and very fine roots; many fine and very fine pores; 5 to 10 percent wormholes partially filled with dark material from the A horizon; neutral ; gradual irregular boundary.

A'2-33 to 39 inches; light brownish gray (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine and fine pores; common fine iron-manganese concretions; slightly acid; clear irregular boundary.

B'&A'-39 to 45 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; moderate fine and medium prismatic structure; very hard, very firm, sticky and plastic; few fine roots; many

fine and very fine pores; continuous thin clay films on pedes and in pores; A2 tongues of light brownish gray (10YR 6/2) silt loam; common fine iron-manganese concretions; slightly acid; clear irregular boundary.

B'21t-45 to 50 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; many fine and very fine pores; continuous thin clay films on pedes and in pores; few light brownish gray (10YR 6/2) coatings on pedes; common fine iron-manganese concretions ; slightly acid; clear irregular boundary.

B'22t-50 to 60 inches; light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium subangular blocky structure ; very hard, very firm, sticky and plastic; few fine roots; many very fine and fine pores ; continuous thin clay films on pedes and in pores; few light brownish gray (10YR 6/2) coatings on pedes; few fine iron-manganese concretions; neutral; clear wavy boundary.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 to 3 when dry or moist. The A'2 and B'2t horizons contain few to common iron-manganese concretions that are 1 to 3 millimeters in diameter. The B2 horizon has value of 4 or 5 when dry and 3 or 4 when moist. The B'&A' horizon, where present, and B'2t horizon have value of 5 or 6 when dry and 3 or 4 when moist, and they have chroma of 3 or 4. The B2t horizon is heavy silt loam or silty clay loam. The B2t horizon has thin, patchy to thin, continuous clay films on pedes and in pores. Iron-manganese or organic staining occurs on pedes and varies from few to common. Reaction is slightly acid to neutral throughout the profile.

103-Thatuna silt loam, 3 to 7 percent slopes. This gently sloping soil is on north- and east-facing foot slopes. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches, areas of soils that have slopes of more than 7 percent or less and 3 percent, and areas of soils that have a silt loam surface layer and a silty clay subsoil.

Runoff is slow, and the erosion hazard is slight. This soil is saturated with water for short periods at a depth of 18 to 40 inches.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIe-3.

104-Thatuna silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on north and east-facing side slopes and south-facing foot slopes. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches; spots of severely eroded soils, some of which are calcareous;

areas of soils that have a silt loam or silty clay loam surface layer; areas of soils with a silty clay subsoil; and areas of soils that have slopes of more than 25 percent.

Runoff is medium, and the erosion hazard is moderate. This soil is saturated with water for short periods at a depth of 29 to 40 inches.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-4.

105-Thatuna silt loam, 25 to 40 percent slopes. This moderately steep to steep soil is on north- and east-facing side slopes. It has a profile similar to the one described as representative of the series, but the surface layer is 4 to 5 inches thicker.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches; areas of soils that have a thin silt loam surface layer and a silty clay subsoil; spots of severely eroded soils, some of which are calcareous; areas of soils that have a thin surface layer of silt loam or silty clay loam; and areas of soils that have slopes of more than 40 percent.

Runoff is rapid, and the erosion hazard is high. This soil is saturated with water for short periods at a depth of 29 to 40 inches.

This soil is used mainly for alfalfa, grass, wheat, barley, peas, and lentils. Capability unit IVE-4.

106-Thatuna silt loam, 40 to 55 percent slopes. This steep to very steep soil is on north- and east-facing side slopes.

Included with this soil in mapping are areas of soils that have a thin silt loam surface layer and a silty clay loam subsoil; soils that have a silty clay subsoil; severely eroded soils, some of which are calcareous and some of which have a silty clay loam surface layer; soils that are silt loam to a depth of 60 inches; soils in narrow, steep or very steep, semicircular areas, or eyebrows; and soils that have slopes of less than 40 percent.

Runoff is very rapid, and the erosion hazard is very high. This soil is saturated with water for short periods at a depth of 29 to 40 inches.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; North exposure range site (N-3).

107-Thatuna-Tilma silt loams, 7 to 25 percent slopes. These strongly sloping to moderately steep soils are on north- and east-facing side slopes and south-facing foot slopes. This complex consists of 65 percent Thatuna silt loam, 7 to 25 percent slopes, in concave areas and 25 percent Tilma silt loam, 7 to 25 percent slopes, in convex areas.

Included with these soils in mapping are areas of soils that are silt loam to a depth of 60 inches small areas on knobs and ridgetops of severely eroded soils, some of which are calcareous and some of which have a silty clay loam surface layer; areas of soils that have a thin silt loam surface layer and a silty clay loam subsoil; and areas of soils that have slopes of more than 25 percent. Included areas make up about 10 percent of the mapped acreage.

Runoff is medium, and the hazard of erosion is moderate. These soils are saturated with water for short periods at a depth of 18 to 40 inches. These soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-5.

108-Thatuna-Tilma silt loams, 25 to 40 percent slopes.

These moderately steep to steep soils are on north- and east-facing side slopes. This complex consists of 65 percent Thatuna silt loam, 25 to 40 percent slopes, in concave areas and 25 percent Tilma silt loam, 25 to 40 percent slopes, in convex areas. The profiles of Thatuna and Tilma soils are similar to the ones described as representative of their respective series, but the surface layer of the Thatuna soil is 4 to 5 inches thicker and the surface layer of the Tilma soil is 3 to 5 inches thinner.

Included with these soils in mapping are small areas of soils that are silt loam to a depth of 60 inches; areas of severely eroded soils, some of which are calcareous and some of which have a silty clay loam surface layer; areas of soils that have slopes of more than 40 percent; and areas of soils that have a thin silt loam surface layer and a silty clay loam subsoil. Included areas make up about 10 percent of the mapped acreage.

Runoff is rapid, and the hazard of erosion is high. These soils are saturated with water for short periods at a depth of 18 to 40 inches.

These soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVE-5.

109-Thatuna-Naff silt loams, 7 to 25 percent slopes.

These strongly sloping to moderately steep soils are on foot slopes and north-facing side slopes. This complex consists of 70 percent Thatuna silt loam, 7 to 25 percent slopes, in concave areas and 25 percent Naff silt loam, 7 to 25 percent slopes, in convex areas that are generally on knobs and narrow ridges.

Included with these soils in mapping are areas of soils that are silt loam to a depth of 60 inches; spots of severely eroded soils, some of which are calcareous; areas of soils that have a silty clay subsoil; and areas of soils that have slopes of more than 25 percent. An eroded spot symbol is used on some knobs and ridges. Included areas make up about 5 percent of the mapped acreage.

Runoff is medium, and the hazard of erosion is moderate. The Thatuna soil is saturated with water for short periods at a depth of 29 to 40 inches.

These soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-5.

Tilma Series

The Tilma series consists of gently sloping to steep, moderately well drained soils that formed in loess and some volcanic ash underlain by finer textured older loess. These soils are on uplands in the northeastern part of the county. Elevation is 1,800 to 3,000 feet. The native vegetation is Idaho fescue, bluebunch wheatgrass, and snowberry. The annual precipitation is 18 to 23 inches. The frost-free season is 110 to 130 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 14 inches thick. The subsoil extends to a depth of 60 inches. It is grayish brown silt loam to a depth of 18 inches and light brownish gray silt loam to a depth of 21 inches; below this it is pale brown and very pale brown silty clay and silty clay loam (fig. 18).

Tilma soils have moderate permeability above a depth of 18 to 30 inches and slow permeability below a depth of 18 to 30 inches. The available water capacity



**Figure 18.-Profile of Tilma silt loam, 7 to 25 percent slopes.
An abrupt, smooth boundary is at a depth of about 3 feet.**

is moderately high or high. Root penetration is somewhat limited by the silty clay layer in the lower part of the subsoil, but some roots extend to a depth of 60 inches or more. Tilma soils are used mainly for wheat, barley, peas, lentils, grass, and alfalfa.

Representative profile of Tilma silt loam, 7 to 25 percent slopes, in a cultivated area, 1,000 feet north and 400 feet west of the southeast corner of sec. 25, T. 15 N., R. 45 E.:

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure ; slightly hard, friable, slightly

sticky and slightly plastic; many very fine and fine roots; many very fine and fine pores; slightly acid; abrupt smooth boundary.

A1-8 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine pores; neutral ; clear wavy boundary.

B2-14 to 18 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine pores; neutral ; clear wavy boundary.

A'2-18 to 21 inches ; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few roots; many very fine and fine pores; few fine iron-manganese concretions; neutral; abrupt smooth boundary.

B'21t-21 to 35 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; ped faces dark brown (7.5YR 3/3) moist; fades when exposed to air; strong medium and coarse subangular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine roots; many fine and very fine tubular pores; continuous moderately thick clay films on peds and in pores; many fine to very fine iron-manganese concretions; neutral; clear wavy boundary.

B'22t-35 to 40 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; ped faces dark brown (7.5YR 3/3) moist; fades when exposed to air; strong medium and coarse subangular blocky structure; extremely hard, extremely firm, very sticky and very plastic; many very fine and fine pores; continuous moderately thick clay films on peds and in pores; common fine and very fine iron-manganese concretions; common gray coatings on peds ; neutral; clear wavy boundary.

B'3-40 to 60 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; strong medium and coarse subangular blocky structure; very hard, very firm, sticky and plastic ; many very fine and fine pores; continuous thin clay films on peds and in pores; few fine and very fine iron-manganese concretions; many gray coatings on peds; mildly alkaline.

Thickness of the Ap and A1 horizons is 10 to 20 inches. They have value of 4 or 5 when dry and 2 or 3

when moist, and they have chroma of 1 or 2 when dry or moist. The B2 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The A2 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2. It has few fine or common fine iron-manganese concretions. Depth to the B'2t horizon is 18 to 30 inches. The B'2t horizon is 35 to 45 percent clay. It has value of 5 or 6 when dry and 3 or 4 when moist, chroma of 3 or 4, and hue of 7.5YR or 10YR. It contains few to many fine and very fine iron-manganese concretions. Clay films range from thin patchy to moderately thick and continuous. In some pedons the B'2t horizon has few to many gray coatings on peds. The B3 horizon has value of 6 or 7 when dry and 4 or 5 when moist, and it has chroma of 3 or 4.

110-Tilma silt loam, 3 to 7 percent slopes. This gently sloping soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker.

Included with this soil in mapping are areas of soils that are silty clay loam at a depth of 40 inches, soils that are silt loam to a depth of 60 inches, somewhat poorly drained soils, and severely eroded soils.

Runoff is slow, and the erosion hazard is slight. This soil is saturated with water for short periods above the slowly permeable subsoil.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IIIe-5.

111-Tilma silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have a silty clay loam subsoil below a depth of 40 inches, soils that are silt loam to a depth of 60 inches, and somewhat poorly drained soils.

Runoff is medium, and the hazard of erosion is moderate. This soil is saturated with water for short periods above the silty clay layer in the lower part of the subsoil.

This soil is used for wheat, barley, lentils, peas, grass, and alfalfa. Capability unit IIIe-5.

112-Tilma silt loam, 25 to 40 percent slopes. This moderately steep and steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 3 to 5 inches thinner.

Included with this soil in mapping are areas of soils that are silty clay loam below a depth of 40 inches, silt loams that are 60 inches deep, soils that have a silty clay loam surface layer and subsoil, and severely eroded soils.

Runoff is rapid, and the erosion hazard is high. This soil is saturated with water for short periods above the silty clay layer in the lower part of the subsoil.

This soil is used mainly for wheat, barley, peas, lentils, grass, and alfalfa. Capability unit IVe-5.

Tucannon Series

The Tucannon series consists of nearly level to moderately steep, well drained soils underlain by basalt bedrock at a depth of 20 to 40 inches. These soils formed in loess and some volcanic ash and weathered

underlying basalt. They are on uplands that border steep side slopes along drainageways in channeled scablands in the northwestern part of the county. Elevation is 1,800 to 3,000 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 16 to 23 inches. The frost-free season is 110 to 130 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 13 inches thick. The upper part of the subsoil, to a depth of 26 inches, is brown and pale brown silt loam. The lower part, to a depth of 30 inches, is pale brown gravelly silt loam. It is underlain by basalt bedrock. There are basalt fragments larger than 2 millimeters throughout the soil; the amount increases with depth.

Tucannon soils have moderate permeability. The available water capacity is moderate and moderately high. Roots penetrate to bedrock. Tucannon soils are used mainly for wheat, barley, peas, lentils, grass, alfalfa, range, and wildlife habitat.

Representative profile of Tucannon silt loam, 7 to 25 percent slopes, in a cultivated area, 170 feet west and 250 feet north of the southeast corner of sec. 29, T. 17 N., R. 44 E.:

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; slightly acid; abrupt smooth boundary.

A3-8 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine pores; neutral; clear wavy boundary.

B21-13 to 22 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate fine and medium prismatic structure parting to moderate fine and medium blocky; hard, friable, slightly sticky and plastic; common fine roots; common very fine pores; few thin clay films on some ped surfaces; neutral; clear wavy boundary.

B22-22 to 26 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak fine and medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, slightly sticky and plastic; common fine roots; many fine pores; few thin patchy clay films on ped faces and in pores; neutral; clear wavy boundary.

B3-26 to 30 inches; pale brown (10YR 6/3) gravelly silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine and medium pores; 20 percent gravel and cobbles;

neutral; clear wavy boundary.
IIR-30 inches ; basalt.

Basalt is at a depth of 20 to 40 inches. The control section, between a depth of 10 inches and bedrock, is 18 to 25 percent clay. It is 5 to 25 percent coarse basalt fragments in places. The profile is slightly acid to neutral throughout.

Thickness of the A horizon is 12 to 18 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when 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.

113-Tucannon silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands that border steep side slopes of major drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have bedrock at a depth of less than 20 inches, soils that are more than 60 inches deep, and Rock outcrop.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for wheat, barley, peas, lentils, grass, alfalfa, range, and wildlife habitat. Capability unit IVE-12 ; Loamy range site (L-3).

114-Tucannon-Bakeoven complex, 0 to 30 percent slopes. These nearly level to moderately steep soils are on side slopes along drainageways. This complex consists of 40 percent Tucannon silt loam, 7 to 25 percent slopes, and 30 percent Bakeoven very cobbly loam that has slopes of 0 to 30 percent.

Included with these soils in mapping are areas of soils that have bedrock at a depth of less than 20 inches ; deep, very stony soils on colluvial slopes; Rock outcrop ; soils that are 20 to 40 inches deep to gravel and cobbles; and somewhat poorly drained soils in depressions. Included areas make up about 30 percent of the mapped acreage.

Runoff is *very* slow to medium, and the erosion hazard is slight or moderate.

This soil is used mainly for range and for wildlife habitat. Capability unit VIs-1; Tucannon part in Loamy range site (L-3), Bakeoven part in Very Shallow range site.

Uhlig Series

The Uhlig series consists of strongly sloping, well drained soils that formed in glacial outwash mixed in the upper part with loess and some volcanic ash. The soils are on terraces in the northwestern part of the county. Elevation is 1,800 to 2,300 feet. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and snowberry. The annual precipitation is 17 to 19 inches. The frost-free season is 130 to 140 days.

In a representative profile the surface layer is dark grayish brown silt loam about 21 inches thick. The upper part of the subsoil, to a depth of 30 inches, is brown silt loam. The lower part, to a depth of 41 inches, is brown loam. The substratum, to a depth of 60 inches, is brown loam and fine sandy loam. A few gravel- and cobble-size fragments are in places on the surface and throughout the profile.

Uhlig soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth

of 60 inches or more. Uhlig soils are used mainly for wheat, barley, and peas.

Representative profile of Uhlig silt loam, 7 to 15 percent slopes, in a cultivated area, 95 feet west and 2,500 feet south of the northeast corner of sec. 3, T. 19 N., R. 40 E.:

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; many very fine and fine pores; slightly acid; abrupt smooth boundary.

A1-8 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots ; many very fine and fine pores; neutral ; clear wavy boundary.

A12-15 to 21 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common fine and medium pores; neutral ; clear wavy boundary.

B1-21 to 30 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; many roots; common fine and medium pores; mildly alkaline; clear wavy boundary.

B2-30 to 41 inches ; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; soft, slightly hard, friable, slightly sticky and slightly plastic; common roots; common very fine and fine pores; mildly alkaline ; clear wavy boundary.

C1-41 to 55 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; massive; slightly sticky and slightly plastic; common roots; very fine and fine pores; 1 to 1 1/2-inch lenses of sand and gravel; mildly alkaline; clear wavy boundary.

C2-55 to 60 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; few roots; very fine and fine pores; mildly alkaline.

The control section, between depths of 10 and 40 inches, averages less than 18 percent clay.

Thickness of the A horizon is 20 to 30 inches. The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. The C horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 when moist or dry.

115-Uhlig silt loam, 7 to 15 percent slopes. This strongly sloping soil is on terraces.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches and areas of soils that are 20 to 40 inches deep to gravel, cobbles, or basalt.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, and peas. Capability unit IIIe-3.

Walla Walla Series

The Walla Walla series consists of gently sloping to very steep, well drained soils that formed in loess and some volcanic ash. The soils are on uplands in the southwestern part of the county. Elevation is 1,200 to 2,200 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 130 to 155 days.

In a representative profile the surface layer is dark grayish brown and grayish brown silt loam about 16 inches thick. The subsoil, to a depth of 41 inches, is brown and pale brown silt loam. The substratum, to a depth of 60 inches, is pale brown silt loam.

Walla Walla soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Walla Walla soils are used mainly for wheat, barley, alfalfa, grass, range, and wildlife habitat.

Representative profile of Walla Walla silt loam, 7 to 25 percent slopes, in an area of grassland, 700 feet west of the southeast corner of sec. 33, T. 15 N., R. 40 E.:

- A11-0 to 5 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; neutral; abrupt smooth boundary
- A12-5 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; few fine tubular pores; neutral; clear wavy boundary.
- B1-16 to 23 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; common roots; few fine tubular pores; mildly alkaline; clear wavy boundary.
- B2-23 to 31 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; common roots; few fine tubular pores; neutral; clear wavy boundary.
- B3-31 to 41 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium and coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine

tubular pores; mildly alkaline; clear wavy boundary.

C-41 to 60 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; mildly alkaline.

Depth to secondary carbonates is 43 to more than 60 inches. The control section, between depths of 10 and 40 inches, is less than 18 percent clay.

Thickness of the A horizon is 10 to 16 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. The C horizon has value of 5 or 6 when dry and 3 or 4 when moist. The soil is neutral in the A horizon, neutral to mildly alkaline in the B horizon, and mildly alkaline to strongly alkaline in the C horizon.

116-Walla Walla silt loam, 3 to 7 percent slopes. This gently sloping soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker.

Included with this soil in mapping are areas of soils that have slopes of more than 7 percent and soils that have a lime-silica hardpan at a depth of 20 to 40 inches. Also included are circular areas called slick spots.

Runoff is slow, and the erosion hazard is slight.

This soil is used mainly for wheat, barley, range, and wildlife habitat. Capability unit IIe-1; Loamy range site (L-2).

117-Walla Walla silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that have slopes of more than 25 percent; spots, ridges, and knobs of severely eroded soils; areas of soils that have slopes of less than 7 percent; and areas of soils that have a lime-silica hardpan at a depth of 20 to 40 inches. Also included are circular areas called slick spots.

Runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wheat, barley, range, and wildlife habitat. Capability unit IIIe-2; Loamy range site (L-2).

118-Walla Walla silt loam, 15 to 30 percent slopes, eroded. This moderately steep soil is on uplands. It has a profile similar to the one described as representative of the series, but 8 to 10 inches of the original surface layer has been removed by erosion.

Included with this soil in mapping are concave areas of soils that have a surface layer 10 to more than 18 inches thick, areas on ridgetops and knobs of soils that have a calcareous surface layer, and areas of soils that have a lime-silica hardpan at a depth of 20 to 40 inches. Also included are circular areas called slick spots.

Runoff is medium to rapid, and the erosion hazard is moderate or high.

This soil is used mainly for wheat, alfalfa, and grass. Capability unit IVe-2.

119-Walla Walla silt loam, 25 to 40 percent slopes. This moderately steep soil is on uplands. It has a pro-

file similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are areas of volcanic ash; spots of severely eroded soils, some of which are calcareous; areas on ridgetops and knobs of soils that have a thin surface layer; and areas of soils that have slopes of more than 40 percent.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for wheat, alfalfa, grass, range, and wildlife habitat. Capability unit IVe-2; Loamy range site (L-2).

120-Walla Walla silt loam, 30 to 40 percent slopes, eroded. This steep soil is on uplands. It has a profile similar to the one described as representative of the series, but 8 to 10 inches of the original surface layer has been removed by erosion.

Included with this soil in mapping are concave areas of soils that have a surface layer 10 to more than 18 inches thick, soils that have a calcareous surface layer, soils that have slopes of more than 40 percent, and soils that have slopes of less than 30 percent.

Runoff is rapid, and the erosion hazard is high.

This soil is used mainly for wheat, barley, alfalfa, and grass. Capability unit VIe-2.

121-Walla Walla silt loam, 40 to 55 percent slopes. This steep to very steep soil is generally on north-facing side slopes on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is 3 to 4 inches thinner.

Included with this soil in mapping are spots of severely eroded soils, some of which are calcareous; areas on ridges and knobs of soils that have a thin surface layer; and spots of volcanic ash.

Runoff is very rapid, and the erosion hazard is very high.

This soil is used mainly for range and for wildlife habitat. Capability unit VIe-1; North exposure range site (N-1).

Walvan Series

The Walvan series consists of strongly sloping to moderately steep, well drained soils that formed in loess and volcanic ash. The soils are on east- and north-facing side slopes of uplands in the southwestern part of the county.

Elevation is 1,200 to 2,200 feet. The native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The annual precipitation is 12 to 15 inches. The frost-free season is 130 to 150 days.

In a representative profile the surface layer is grayish brown silt loam about 14 inches thick. The underlying material is brown very fine sandy loam to a depth of 27 inches, pale brown fine sandy loam to a depth of 40 inches, and very pale brown silt loam to a depth of 60 inches.

Walvan soils have moderate permeability. The available water capacity is high. Roots penetrate to a depth of 60 inches or more. Walvan soils are used mainly for wheat, alfalfa, grass, range, and wildlife habitat.

Representative profile of Walvan silt loam, 7 to 25 percent slopes, in a cultivated area, 2,200 feet west and 1,500 feet north of the southeast corner of sec. 26, T. 14 N., R. 37 E.:

Ap-0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine tubular pores; many very fine roots; neutral; abrupt smooth boundary.

A1-6 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; many fine tubular pores; neutral; gradual wavy boundary.

C1-14 to 27 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many fine tubular pores; neutral; gradual wavy boundary.

C2-27 to 40 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common fine tubular pores; few very fine roots; mildly alkaline; clear smooth boundary.

C3ca-40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline.

Thickness of the A horizon is 10 to 20 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The C horizon has value of 5 to 7 when *dry* and 4 or 5 when moist. It is silt loam, very fine sandy loam, or fine sandy loam. It is neutral to mildly alkaline to a depth of 40 inches and is moderately alkaline at a depth of more than 40 inches.

122-Walvan silt loam, 7 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands.

Included with this soil in mapping are areas of soils that are silt loam to a depth of 60 inches, soils that have slopes of more than 25 percent, and soils that have slopes of less than 7 percent.

Runoff is medium. The erosion hazard is moderate, and the soil blowing hazard is high.

This soil is used mainly for wheat, alfalfa, grass, range, and wildlife habitat. Capability unit IVe-9; Loamy range site (L-2).

Xerofluvents

123-Xerofluvents, 0 to 15 percent slopes. Xerofluvents are deep, somewhat excessively drained and excessively drained, nearly level to strongly sloping soils that formed in cobbly alluvium. These soils are on bottom lands, terraces, and alluvial fans along the Snake and Palouse Rivers. They are stratified very cobbly sand, very gravelly coarse sand, or very stony coarse sand to a depth of 60 inches. These soils are subject to flooding in winter and in spring. Vegetation

is sparse willows, shrubs, and grasses. Mean annual precipitation is 11 to 18 inches. Mean annual air temperature is about 50° F, and the frost-free season is 150 to 160 days.

These soils have value for wildlife habitat, for recreational areas, and for esthetic purposes. Capability unit VIIIw-1.

Use and Management of the Soils

This section contains information about the use and management of the soils in the survey area for crops and pasture, range, woodland, windbreaks, wildlife habitat, and engineering. It explains the system of capability classification used by the Soil Conservation Service and gives estimated yields of the principal crops.

Crops and pasture

Agriculturally, the survey area is divided into two major areas: the eastern and the western. Each area has conservation problems peculiar to it, and a different kind of farming must be developed for each.

The eastern area is one of large farms and deep soils that are used for dryland crops. Controlling erosion is the major conservation concern, especially on most cultivated soils. Controlling weeds and maintaining fertility and organic matter are also concerns.

Rain and melting snow often cause excessive runoff and severe erosion, particularly when the surface layer is frozen. On the steepest soils, surface soil is moved down slope with each tillage operation.

Most of the soils in the area are high in content of organic matter and have good tilth. However, eroded soils have less organic matter in the surface layer, absorb water more slowly, store less moisture, and are more susceptible to erosion. Crop residue, fertilizer, and green manure crops are needed to maintain organic-matter content, fertility, and good tilth on these soils.

The cropping systems generally used in the area are (1) wheatpeas or lentils, (2) annual grains, and (3) grass for seed. Combinations and variations of these systems are also practiced, including rotation with grasses and legumes and in some cases summer fallow.

Returning all crop residue to the soil helps to maintain the organic-matter content at a desirable level. Tillage equipment has been improved in recent years to make residue easier to use. Also, shorter strawed varieties of grain have been developed, and commercial fertilizers are now available that make it possible to use large amounts of residue and still maintain economic yields.

Where annual cropping of grain is practical, the residue should be mixed throughout the tillage layer of the soil. Plowing under residue in a layer or leaving too much residue on the surface impedes water intake, root penetration, and plant growth. Peas and lentil vines are best utilized when left on the surface.

Where summer fallow is used, crop residue should be left on the surface, where it provides maximum protection against erosion, increases water intake rate,

and helps to reduce evaporation loss. If a stubble mulch-fallow system is properly managed, crop residue is mixed in the tillage layer, and at least 2,000 pounds of the residue is on the surface at seeding time.

Tillage operations should be kept to the minimum necessary to control weeds and prepare a suitable seedbed. Also important is the careful operation of tillage implements and tilling only when the soil is not too wet or too dry.

Commercial fertilizers are used commonly and should be applied according to soil tests, field trials, and crop needs. Fertilizers help to produce a good protective cover and make possible the full use of all available moisture.

Field diversions and terraces are helpful in controlling erosion and increasing water intake rates in some areas. They are designed either to intercept surface runoff and hold the water in place until it infiltrates or carry it off the slope at a slow rate to a place where it can be disposed of safely. Level terraces are suitable on deep silt loams that have less than 6 percent slopes. Gradient terraces or diversions are used on soils that have 6 to 15 percent slopes. All such diversions must have protected outlets, and emergency outlets are advisable for level terraces. Drop structures and debris basins or sediment traps should be used in conjunction with most terraces and diversion systems. Careful design and construction are necessary.

Grassed waterways are needed in field draws to prevent gully erosion caused by runoff. They also can serve as outlets for gradient terraces and diversions.

Cross-slope farming is an effective method of reducing runoff and controlling erosion. On long slopes, planting crops in transverse strips prevents the exposure of the entire slope to runoff at any one time. Stripcropping, cover vegetation, and crops planted in alternate bands reduce soil loss on long slopes.

Where the slope and topography do not permit cropping in multiple strips, half of the slope can be planted to protective cover vegetation and half to a crop. This method is called "divided-slope farming." For best results, strips should be as nearly on the contour as practical.

The western area consists of large farms, deep soils, and channeled scablands. These soils are used mainly for grain farming and livestock operations. Precipitation in much of this area is slightly less than is needed to make annual cropping consistently practical. The most practical cropping system is one in which winter grains alternate with stubble mulch-fallow. This system necessitates special attention to control erosion. Conservation benefits can be obtained by adding a rotation of alfalfa and grass to the system.

Runoff interception and water disposal are suitable for some of the cropland, where slopes are less than 20 percent. Grassed waterways are needed as outlets for diversion terraces or gradient terraces and for the control of gully erosion in field draws. Many of the slopes are suitable for contour farming or field stripcropping. Strips of grain fallow should alternate with strips of alfalfa and grass. At least 2,000 pounds of residue should be left on the surface at seeding time. Minimum tillage during the fallow season helps to control pulverization of the soil. Application of fertilizer in accordance with soil tests, field trials, and crop

needs makes possible the efficient use of available soil moisture and produces a good protective cover. During seasons when there is favorable moisture and soils hold a good supply of it, annual cropping is preferable to alternate cropping and fallow.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the capability class, subclass, and unit. These are explained 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, defined as follows

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture, range, woodland, or wildlife habitat.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

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 too cold or too dry.

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

CAPABILITY UNITS are soil groups within the subclass. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Whitman County are described and suggestions for the use and management of the soils are given.

The capability unit to which each soil has been assigned is given, with the range site, in the mapping unit description in the section "Descriptions of the Soils."

CAPABILITY UNIT IIe-1

This unit consists of well drained Chard and Walla Walla soils. These soils are more than 60 inches deep. Slopes range from 3 to 7 percent. Permeability is moderate to moderately rapid, and the available water capacity is high. Surface runoff is slow, and the erosion hazard is slight. The annual precipitation ranges from 12 to 15 inches. The frost-free season is 130 to 155 days.

Wheat, barley, alfalfa, and grass are the principal crops. These soils are generally farmed in a wheat-fallow rotation, or 2 years of wheat followed by 1 year of fallow. In some years the moisture supply is too low for annual cropping.

These soils can be farmed without excessive erosion if waterways are shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; tillage is across the slopes; and fall grain is seeded early enough to provide winter cover. If no winter cover crop is grown and no stubble is left standing, the surface is kept rough and cloddy. Terraces, diversions, and stripcropping are needed to help control erosion on long slopes that have no grass and legume cover. Chiseling in fall to a depth of more than 10 inches is needed in places to break up the tillage pan. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth.

Grain and grass respond to nitrogen fertilizers, and legumes respond to sulfur and phosphorus fertilizers.

CAPABILITY UNIT IIe-2

This unit consists of well drained Athena and Calouse soils. These soils are more than 60 inches deep. Slopes range from 3 to 7 percent. Permeability is moderate, and the available water capacity is high. Surface runoff is slow, and the erosion hazard is slight. The annual precipitation ranges from 15 to 18 inches. The frost-free season is 120 to 140 days.

Wheat, barley, peas, alfalfa, and grass are the principal crops. These soils can be cropped annually with intermittent fallow in the rotation. Crop rotations generally used are wheat-fallow, wheat-barley-fallow, annual grain, or wheat-peas-wheat-fallow.

These soils can be farmed without excessive erosion if waterways are shaped, packed, and seeded to grass; crop residue is mixed in the tillage layer; maximum residue of straw is left on the surface at seeding time; tillage is across the slope; and fall grain is seeded early enough to provide winter cover. If no winter cover crop is grown and no stubble is left standing, the surface is kept rough and cloddy. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. Terraces, diversions, or stripcropping is needed to help control erosion on long slopes that have no grass and legume cover. Chiseling to a depth of more than 10 inches will break up the tillage pan.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth.

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

CAPABILITY UNIT IIe-3

This unit consists of well drained Palouse soils and moderately well drained Thatuna soils. These soils are more than 60 inches deep. Slopes range from 3 to 7 percent. Permeability is moderate to moderately slow, and the available water capacity is high. Surface runoff is slow, and the erosion hazard is slight. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 110 to 130 days.

Wheat, barley, dry peas, lentils, grass for seed, and alfalfa and grass for hay or pasture are the principal crops. These soils can be cropped annually. They are commonly farmed in the following rotations: wheat-fallow, wheat-peas or lentils, annual grains, grass for seed, 3 years of wheat-barley-peas or lentils, and 3 years of alfalfa and grass.

These soils can be farmed without excessive erosion if all crop residue is mixed into the tillage layer; maximum residue is left on the surface at seeding time; the surface is rough and cloddy during winter; waterways are properly shaped, packed, and seeded to grass; and fall grain is seeded early enough to provide winter cover. Contour tillage is needed in places where the slopes are more than 5 percent. Terraces, diversions, and stripcropping are needed to help control erosion on long slopes that have no grass and legume cover. Chiseling to a depth of more than 10 inches will break

up the tillage pan. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff.

Grasses and legumes in the rotation help to maintain or improve tilth and to control erosion.

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

CAPABILITY UNIT IIw-1

This unit consists of somewhat poorly drained Covello and Pedigo soils. These soils are more than 60 inches deep. Slopes range from 0 to 3 percent. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and there is little or no erosion hazard. Wetness restricts root penetration and delays spring tillage. The annual precipitation ranges from 15 to 20 inches. The frost-free season is 130 to 155 days.

Wheat, barley, and grass and clover for hay and pasture are the principal crops. These soils can be cropped annually. They are commonly farmed in grain-fallow, annual grain, or legume-grass rotations.

Good management for these soils includes shaping and packing waterways and seeding them to grass, mixing crop residue into the tillage layer, and leaving maximum residue of straw on the surface at seeding time. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. If no winter cover crop is grown and no stubble is left standing, the surface is kept rough and cloddy. In some years winter wheat is drowned out by water that ponds in depressions. Open drains or tile drains are needed in such places. Chiseling is needed in places every few years to break up the tillage pan. Pans form quickly if the soils are cultivated when wet.

Grasses and legumes in the rotation help to maintain or improve tilth.

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

CAPABILITY UNIT IIw-2

This unit consists of somewhat poorly drained Caldwell soils. These soils are more than 60 inches deep. Slopes range from 0 to 3 percent. Permeability is moderately slow, and the available water capacity is high. Surface runoff is very slow, and there is little or no erosion hazard. Root penetration and spring tillage are restricted by wetness. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 100 to 135 days.

These soils can be cropped annually. Wheat, barley, oats, lentils, peas, grass for seed, and legumes and grass for hay or pasture are the principal crops. They are commonly grown in the following rotations: wheat-peas or lentils, wheat-barley-peas or lentils, annual grain, grass for seed, and hay or pasture.

Good management for these soils includes properly shaping and packing waterways and seeding them to grass, mixing crop residue into the tillage layer, and leaving maximum residue on the surface at seeding time. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. If no winter cover crop is grown and no stubble is

left standing, the surface is kept rough and cloddy. In some years winter wheat is drowned out by water that ponds in depressions. Open drains or tile drains are needed in such areas. Chiseling is needed in places every few years to break up the tillage pan. Pans form quickly if the soils are cultivated when wet.

Grasses and legumes in rotation help to maintain or improve tilth.

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

CAPABILITY UNIT IIe-1

This unit consists of well drained Hermiston, Onyx, and Mondovi soils. These soils are more than 60 inches deep. Slopes are 0 to 3 percent. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and there is little or no erosion hazard. The annual precipitation ranges from 12 to 18 inches. The frost-free season is 130 to 155 days.

These soils can be farmed in a grain-fallow or annual grain rotation. Wheat and barley are the principal crops. Occasionally legumes and grasses are grown for hay or pasture.

Good management for these soils includes properly shaping and packing waterways and seeding them to grass, mixing crop residue into the tillage layer, leaving maximum residue of straw on the surface at seeding time, and seeding fall grain early enough to provide winter cover. If steeper soils are upslope from these soils, diversions are needed in places to intercept runoff. Chiseling in fall to a depth of more than 10 inches is needed in places every fallow year to break up the tillage pan. If no stubble is left standing and no winter cover crop is grown, the surface is kept rough and cloddy.

Grasses and legumes help to maintain or improve tilth.

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

CAPABILITY UNIT IIIe-1

This unit consists of well drained Farrell and Ritzville soils. These soils are more than 60 inches deep. Slopes range from 0 to 30 percent. Permeability is moderate, and the available water capacity is high. Generally, surface runoff is very slow to medium and the hazard of water erosion is slight or moderate. If the ground is frozen, runoff is medium to rapid and soil erosion is moderate to severe during rainfall or when snow melts. The annual precipitation ranges from 11 to 12 inches. The frost-free season is 140 to 155 days.

Wheat, alfalfa, and grass are the principal crops. These soils are farmed in grain-fallow or alfalfa and grass rotations. Winter wheat produces higher yields than spring wheat. Yields of spring grain are low, and the amount of straw produced is insufficient to control erosion. Alfalfa and grass are used for pasture.

These soils can be farmed in a grain-fallow rotation without excessive erosion if waterways are properly shaped, packed, and seeded to grass; stubble mulch tillage is used; tillage is on the contour or across the slope; crop residue is mixed into the tillage layer; max-

imum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; and fall grain is seeded early enough to provide winter cover. Divided slopes, terraces, diversions, or stripcropping is needed to help control erosion on long slopes that have no grass or legume cover. Chiseling in fall to a depth of more than 10 inches is needed in places to break up the tillage pan.

Grass and alfalfa help to control erosion and to maintain or improve tilth. When plowing out a crop of grasses or legumes, the plow furrow should be turned uphill.

Grasses and grain respond to nitrogen fertilizers, and alfalfa responds to sulfur and phosphorus fertilizers.

CAPABILITY UNIT IIIe-2

This unit consists of well drained Chard, Endicott, and Walla Walla soils. These soils are mainly more than 60 inches deep, but Endicott soils are underlain by a lime-silica cemented hardpan at a depth of 20 to 40 inches. Slopes range from 3 to 25 percent. Permeability is moderate in Chard and Walla Walla soils. It is moderate in Endicott soils to a depth of 20 to 40 inches and very slow below a depth of 20 to 40 inches. The available water capacity is high in Walla Walla and Chard soils, and it is moderate to moderately high in the Endicott soils. Generally, surface runoff is slow to medium and the hazard of water erosion is slight to moderate. If the ground is frozen, runoff is rapid and soil erosion is severe during rainfall or when snow melts. The annual precipitation ranges from 12 to 15 inches. The frost-free season is 130 to 155 days.

Wheat, barley, alfalfa, and grass are the principal crops. Alfalfa and grass are used for hay or pasture.

These soils can be farmed in grain-fallow, 2 years of grain followed by 1 year of fallow, or annual grain rotations. They can be farmed without excessive erosion if waterways are properly shaped, packed, and seeded to grass; tillage is on the contour; fall grain is seeded early enough to provide winter cover; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; and the surface is left rough and cloddy during winter. Diversions or stripcropping are needed to help to control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. Chiseling in fall to a depth of more than 10 inches is needed every fallow year to break up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When plowing out a crop of grass or alfalfa, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IIIe-3

This unit consists of well drained Athena, Calouse, Reardan, and Uhlig soils. These soils are more than 60 inches deep. Slopes range from 3 to 25 percent. Permeability is moderate in Athena, Calouse, and

Uhlig soils. It is moderate in Reardan soils to a depth of about 15 inches and slow at a depth of more than 15 inches. Generally, surface runoff is slow to medium and the hazard of water erosion is slight to moderate. If the ground is frozen, runoff is rapid and water erosion is severe during rainfall or when snow melts. The annual precipitation ranges from 15 to 19 inches. The frost-free season is 100 to 140 days. The available water capacity is high.

These soils can be cropped annually with intermittent fallow in the rotations. Wheat, barley, peas, alfalfa, and grass are the principal crops. They are commonly grown in wheat-fallow, annual grain, wheat-peas-wheat-barley-fallow, or wheat-barley-fallow rotations. Alfalfa and grass are used for hay or pasture.

These soils can be farmed without excessive erosion if waterways are shaped, packed, and seeded to grass; tillage is on the contour; fall grain is seeded early enough to provide winter cover; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; and the surface is rough and cloddy during winter. Terraces, diversions, or stripcropping is needed to help control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. Chiseling to a depth of more than 10 inches is needed to break the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When plowing out a crop of grass and legumes, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IIIe-4

This unit consists of well drained Palouse and Snow soils and moderately well drained Thatuna soils. These soils are more than 60 inches deep. Slopes range from 7 to 25 percent. Permeability is moderate in Palouse and Snow soils. It is moderate in Thatuna soils to a depth of 39 inches and moderately slow below a depth of 39 inches. The available water capacity is high. Generally, surface runoff is medium and the erosion hazard is moderate. If the ground is frozen, runoff is rapid and erosion is severe during rainfall or when snow melts. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 110 to 130 days.

These soils can be cropped annually. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. They are commonly grown in wheat-fallow, wheat-peas or lentils, or annual grain rotations. Other rotations are grass for seed or alfalfa and grass for 3 years and wheat-barley-peas or lentils for 3 years.

These soils can be farmed without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; tillage is minimal and on the contour; and fall grain is seeded early enough to provide winter cover. Terraces, diversions, divided slopes, or strip-cropping is needed to help control erosion on long slopes that have no grass or legume cover. If steeper

soils are upslope from these soils, diversions are necessary in places to intercept runoff. Chiseling to a depth of more than 10 inches after harvest breaks up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring. If no winter cover crop is grown and no stubble is left standing, the surface is kept rough and cloddy.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When plowing out a crop of grasses or legumes, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IIIe-5

This unit consists of well drained Naff soils and moderately well drained Thatuna and Tilma soils. These soils are more than 60 inches deep. Slopes range from 3 to 25 percent. Permeability is moderately slow in Naff and Thatuna soils and slow in Tilma soils. The available water capacity is moderately high to high. Generally, surface runoff is slow to medium and the erosion hazard is slight to moderate. If the ground is frozen, runoff is rapid and erosion is severe during rainfall or when snow melts rapidly.

These soils can be cropped annually. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. They are commonly grown in wheat-peas or lentils or annual grain rotations. Other rotations are grass for seed and 3 years of wheat-barley-peas or lentils, or 4 years of wheat-peas or lentils in combination with 3 years or more of alfalfa and grass.

These soils can be farmed without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; tillage is minimal and on the contour; and fall grain is seeded early enough to provide winter cover. Terraces, diversions, divided slopes, or stripcropping is needed to help control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. Chiseling to a depth of more than 10 inches after harvest breaks up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring. If no winter cover crop is grown and no stubble is left standing, the surface is kept rough and cloddy during winter and early spring.

Grasses and legumes in rotation help to control erosion and to maintain or improve tilth. When plowing out a crop of grasses or legumes, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IIIe-6

This unit consists of well drained Anders and Benge soils and somewhat excessively drained Beckley soils. These soils are 20 to 40 inches deep over bedrock, gravel and cobbles, or basaltic sand. Slopes range from 0 to 20 percent. Permeability is moderate in Anders and Benge soils and moderately rapid in Beckley soils.

The available water capacity is moderate to moderately high in Anders and Benge soils and low to moderate in Beckley soils. Generally, surface runoff is very slow to medium and the erosion hazard is slight to moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 12 to 16 inches. The frost-free season is 135 to 150 days.

Wheat, barley, alfalfa, and grass are the principal crops. These soils are generally farmed in a wheat-fallow rotation.

These soils can be farmed without excessive erosion if waterways are shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; tillage is minimal and across the slope; fall grain is seeded early enough to provide winter cover; and maximum residue of straw is left on the surface at seeding time. Terraces, diversions, and stripcropping are needed to help control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. If no stubble is left standing, the surface is kept rough and cloddy during winter.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When plowing out a crop of grasses or legumes, the plow furrow should be turned uphill. Chiseling to a depth of more than 10 inches after harvest breaks up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

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

CAPABILITY UNIT IIIe-7

Cheney silt loam, 0 to 7 percent slopes, is the only soil in this unit. This soil is 20 to 40 inches deep over sand, gravel, and cobbles. It is well drained. Permeability is moderate, and the available water capacity is moderate or moderately high. Generally, surface runoff is very slow to slow and the erosion hazard is slight. If the ground is frozen, runoff is medium and the erosion hazard is moderate during rainfall or when snow melts. The annual precipitation is 15 to 18 inches. The frost-free season is 130 to 140 days.

This soil can be cropped annually. Wheat, barley, alfalfa, and grass are the principal crops. They are commonly grown in wheat-fallow, wheat-barley-fallow, or annual grain rotations.

This soil can be farmed without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; tillage is minimal and on the contour; and fall grain is seeded early enough to provide winter cover. Terraces, diversions, and stripcropping are needed to help control erosion on long slopes that have no grass and legume cover. If steeper soils are upslope from this soil, diversions are necessary in places to intercept runoff. If no stubble is left standing, the surface is left rough and cloddy during winter and spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When plow-

ing out a crop of grasses and legumes, the plow furrow should be turned uphill. Chiseling to a depth of more than 10 inches after harvest breaks up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

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

CAPABILITY UNIT IIIe-8

This unit consists of well drained Larkin and Shumacher soils. These soils are more than 40 inches deep. Slopes range from 3 to 15 percent. Permeability is moderately slow in the Shumacher soils and moderate to moderately slow in the Larkin soils. The available water capacity is high. Generally, surface runoff is slow to medium and the erosion hazard is slight to moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 100 to 130 days.

These soils can be cropped annually. Wheat, barley, peas, lentils, alfalfa, and grass are the principal crops. They are commonly grown in annual grain, wheat-peas or lentils, and wheat-barley-peas or lentils rotations. Other rotations are wheat-peas or lentils for 4 years and alfalfa and grass for 3 years, or grass for seed for 4 years.

These soils can be farmed without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; tillage is minimal and on the contour; and fall grain is seeded early enough to provide winter cover. If no winter cover crop is grown and no stubble is left standing, the surface is kept rough and cloddy. Terraces, diversions, or stripcropping is needed to help control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. Chiseling to a depth of more than 10 inches is needed in places every second crop to break up the tillage pan. It also allows deeper penetration of moisture during the winter and reduces runoff in spring.

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

CAPABILITY UNIT IIIw-1

This unit consists of somewhat poorly drained Konert and Latah soils. These soils are more than 60 inches deep. Slopes range from 0 to 3 percent. Permeability is slow in the Konert soils and very slow in the Latah soils, and the available water capacity is high. Root penetration is somewhat limited by the finer textured underlying material and by excess water. Runoff is very slow, and there is little or no erosion hazard. Some areas are subject to flooding and deposition of alluvial sediment. Tillage is delayed in spring because of wetness. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 90 to 135 days.

These soils can be cropped annually. Wheat, barley, oats, lentils, peas, grass, and legumes are the principal crops. They are commonly grown in wheat-barley-peas or lentils, annual grain, or grass and legumes for hay or pasture rotations.

Good management for these soils includes shaping and packing waterways and seeding them to grass, mixing crop residue into the tillage layer, and leaving maximum residue of straw on the surface at seeding time. Keeping stream channels free of debris prevents overflow. If steeper soils are upslope from these soils, diversions are necessary in places to intercept runoff. Chiseling to a depth of more than 10 inches every few years breaks up the tillage pan. Moldboard, disk, or chisel plowing after harvest when the soil is dry leaves the surface rough and cloddy during winter. Early fall seeding provides winter cover. In some years winter wheat is drowned out by water that ponds in depressions. Random tile drains or open ditches are needed in such places.

Grasses and legumes in the rotation help to maintain or improve tilth.

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

CAPABILITY UNIT III_w-2

Narcisse silt loam is the only soil in this unit. This soil is more than 60 inches deep. Slopes range from 0 to 3 percent. This soil is moderately well drained. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and in places there is ponding. There is little or no erosion hazard. Some areas are subject to flooding and deposition of alluvial sediment. Tillage is delayed in spring because of wetness. The annual precipitation ranges from 16 to 23 inches. The frost-free season is 100 to 135 days.

This soil can be cropped annually. Wheat, barley, oats, grass, and legumes are the principal crops. They are commonly grown in rotations of annual grain and grass and legumes for hay or pasture.

Good management for this soil includes properly shaping and packing waterways and seeding them to grass, mixing crop residue into the tillage layer, and leaving maximum residue of straw on the surface at seeding time. Keeping stream channels free of debris prevents overflow. In places where steeper soils are upslope from this soil, diversions are necessary to intercept runoff. Chiseling to a depth of more than 10 inches every few years breaks up the tillage pan. Moldboard, disk, or chisel plowing after harvest when the soil is dry leaves the surface rough and cloddy during winter. Early fall seeding provides winter cover. In some years winter wheat is drowned out by water that ponds in depressions. Random tile drains or open ditches are needed in such places.

Grasses or legumes in the rotation help to maintain or improve tilth.

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

CAPABILITY UNIT IV_e-1

Ritzville silt loam, 30 to 40 percent slopes, is the only soil in this unit. This soil is more than 60 inches

deep. It is well drained. Permeability is moderate, and the available water capacity is high. Generally, surface runoff is rapid and the hazard of erosion is high. If the ground is frozen, runoff is very rapid and the hazard of erosion is very severe during rainfall or when snow melts. The annual precipitation ranges from 11 to 12 inches. The frost-free season is 140 to 155 days.

Wheat, alfalfa, and grass are the principal crops. This soil is commonly farmed in a wheat-fallow rotation, but the hazard of erosion is high. A 6-year grain-fallow and 8-year alfalfa and grass rotation will control excessive erosion. Yields of spring grain are lower than yields of winter grain, and the amount of spring grain stubble is insufficient to control erosion.

This soil can be farmed without excessive erosion if crop residue is mixed into the tillage layer, maximum residue of straw is left on the surface at seeding time, the surface is rough and cloddy during winter, tillage is on the contour or across the slope, and fall grain is seeded early enough to provide winter cover. Stripcropping, divided slope farming, runoff interception, and sediment and grade stabilization structures are suitable for some sites.

Alfalfa and grass help to control erosion and to maintain or improve tilth.

Grain and grasses respond to nitrogen fertilizers, and alfalfa responds to sulfur fertilizers.

CAPABILITY UNIT IV_e-2

This unit consists of well drained Walla Walla soils. These soils are more than 60 inches deep. Slopes range from 15 to 40 percent. Permeability is moderate, and the available water capacity is high. Generally, surface runoff is medium to rapid and the hazard of erosion is moderate to high. If the ground is frozen, runoff is very rapid and the hazard of erosion is very severe during rainfall or when snow melts. The annual precipitation ranges from 12 to 15 inches. The frost-free season is 130 to 155 days.

Wheat, barley, alfalfa, and grass are the principal crops. These soils are commonly farmed in a grain-fallow rotation with grass and alfalfa.

These soils can be farmed in a rotation of 5 to 8 years of grass or alfalfa-grass and 8 years of wheat-fallow (one to three crops of wheat between fallow). This can be done if crop residue is mixed into the soil, maximum residue of straw is left on the surface at seeding time, the surface is rough and cloddy during winter, fall grain is seeded early enough to provide winter cover, and tillage and seeding are on the contour or across the slope. If less steep soils are above these soils, chiseling those soils to a depth of more than 10 inches reduces runoff and the use of level terraces or diversions intercepts runoff before it reaches these soils.

Using stripcropping, divided slopes, and runoff interception and water-disposal structures is suitable for some sites. Controlling growth of weeds by chemicals reduces the need for tillage during the fallow year.

Snow drifting is common on these soils. It smothers fall-seeded grain, permits weed invasion, and causes excessive rill erosion when the snow melts in spring. Snow drifting can be reduced by leaving stubble on hilltops and on the upper part of adjacent south- and west-facing side slopes and by planting a windbreak

of trees and shrubs to intercept the snow before it reaches these soils.

Alfalfa and grass help to control erosion and to improve tilth.

Grain and grasses respond to nitrogen fertilizers, and alfalfa responds to sulfur fertilizers.

CAPABILITY UNIT IVe-3

This unit consists of well drained Athena and Calouse soils. These soils are more than 60 inches deep. Slopes range from 5 to 40 percent. Permeability is moderate, and the available water capacity is high. Surface runoff is medium to rapid, and the erosion hazard is moderate to high. The annual precipitation ranges from 15 to 18 inches. The frost-free season is 120 to 140 days.

These soils can be cropped annually. Wheat, barley, alfalfa, and grass are the principal crops.

These soils can be farmed in annual grain or a rotation of several years of alfalfa and grass and several years of annual grain. This can be done without excessive erosion if crop residue is mixed into the tillage layer, maximum residue of straw is left on the surface at seeding time, the surface is rough and cloddy during winter, tillage and seeding are across the slope or on the contour, and fall grain is seeded early enough to provide winter cover. Using stripcropping, divided slopes, and runoff interception and water disposal structures is suitable for some sites. If less steep soils are above these soils, chiseling to a depth of more than 10 inches reduces runoff and intercepts it before it reaches these soils.

Although erosion cannot be controlled in a grain-fallow rotation, it can be greatly reduced by annual rotations and by use of stripcropping or divided slopes with alternate strips of grain and fallow. Controlling growth of weeds by chemicals reduces the need for tillage during the fallow years.

Snow drifting is common on these soils. It smothers fall-seeded grain, permits weed invasion, and causes excessive rill erosion or deep soil slips when the snow melts in spring. Snow drifting can be reduced by leaving stubble on hilltops and on the upper part of adjacent south- and west-facing side slopes and by planting a windbreak of trees to intercept the snow before it reaches these steep soils.

Using alfalfa and grass in the rotation at least half the time helps to control erosion and to improve tilth.

Grain and grasses respond to nitrogen fertilizers, and alfalfa responds to sulfur fertilizers.

CAPABILITY UNIT IVe-4

This unit consists of well drained Palouse soils and moderately well drained Thatuna soils. These soils are more than 60 inches deep. Slopes range from 25 to 40 percent. Permeability is moderate in the Palouse soils. It is moderate in the Thatuna soils to a depth of 39 inches and moderately slow below a depth of 39 inches. The available water capacity is high. Generally, surface runoff is rapid and the erosion hazard is high. If the ground is frozen, runoff is very rapid and erosion is very severe during rainfall or when snow melts. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 110 to 130 days.

These soils can be cropped annually. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops.

These soils can be farmed in annual grain or a rotation of several years of alfalfa and grass and several years of annual grain. This can be done without excessive erosion if crop residue is mixed into the tillage layer, maximum residue is left on the surface at seeding time, the surface is rough or cloddy during the winter, tillage is minimal and on the contour or across slope, and fall grain is seeded early enough to provide winter cover. Chiseling to a depth of more than 10 inches is needed in places to break up the tillage pan. Chisel shank spacing of more than 18 inches is suitable. Chiseling allows deeper penetration of moisture during winter and reduces runoff in spring. Stripcropping and divided slopes are suitable for some sites. Hilltop or ridgetop planting of windbreaks or seedlings of grass and legumes protects slopes from snow drifting and from runoff.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth.

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

CAPABILITY UNIT IVe-5

This unit consists of well drained Naff soils and moderately well drained Thatuna and Tilma soils. These soils are more than 60 inches deep. Slopes range from 25 to 40 percent. Permeability is moderately slow or slow, and the available water capacity is moderately high or high. Generally, surface runoff is rapid and the erosion hazard is high. If the ground is frozen, runoff is very rapid and the hazard of erosion is very severe during rainfall or when snow melts. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 110 to 130 days.

These soils can be cropped annually. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops.

These soils can be farmed in annual grain or rotations of several years of annual grain and several years of alfalfa and grass, or 3 or 6 years of wheat-barley-peas or lentils followed by 5 years or more of grass, or alfalfa and grass. This can be done without excessive erosion if crop residue is mixed into the tillage layer, maximum residue of straw is left on the surface at seeding time, the surface is rough and cloddy during winter, tillage is minimal and on the contour or across slope, and fall grain is seeded early enough to provide winter cover. Chiseling to a depth of more than 10 inches is needed in places to break up the tillage pan. Chisel spacing of more than 18 inches is suitable. Chiseling allows deeper penetration of moisture during winter and reduces runoff in spring. Use of stripcropping, divided slopes, and runoff interception and water disposal structures is suitable for some sites. Hilltop or ridgetop plantings of trees or seedlings of grasses and legumes protect slopes from snow drifting and from runoff.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth.

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

CAPABILITY UNIT IVe-6

Only Beckley sandy loam, 20 to 40 percent slopes, is in this unit. This soil is 20 to 40 inches deep to coarse

basaltic sand. It is somewhat excessively drained. Permeability is moderately rapid, and the available water capacity is low or moderate. Generally, surface runoff is rapid and the erosion hazard is high. If the ground is frozen, runoff is very rapid and the erosion hazard is very severe during rainfall or when snow melts. The annual precipitation ranges from 12 to 15 inches. The frost-free season is 135 to 150 days.

Wheat, barley, alfalfa, and grass are the principal crops. This soil is commonly cropped in a wheat-fallow rotation.

This soil can be farmed in a rotation of barley-fallow-wheat for 3 years followed by alfalfa and grass for 4 years. This can be done without excessive erosion if crop residue is mixed into the tillage layer, maximum residue of straw is left on the surface at seeding time, the surface is left rough and cloddy during winter, tillage is minimal and on the contour or across slope, and fall grain is seeded early enough to provide winter cover.

Grasses and legumes in the rotation help to control erosion and to maintain tilth.

Grain and grasses respond to nitrogen fertilizers, and legumes respond to sulfur fertilizers.

CAPABILITY UNIT IVe-7

This unit consists of a somewhat excessively drained Magallon soil and well drained Roloff and Stratford soils. These soils are 20 to 40 inches deep over bedrock, basaltic sand, or sand and gravel. Slopes range from 0 to 20 percent. Permeability is moderate, and the available water capacity is moderate or moderately high. Generally, surface runoff is very slow to medium and the erosion hazard is slight or moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 11 to 12 inches. The frost-free season is 135 to 160 days.

Wheat is the principal crop. These soils are commonly farmed in a wheat-fallow rotation.

These soils can be farmed without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; tillage is minimal and on the contour or across the slope; and fall grain is seeded early enough to provide winter cover. Use of divided slopes, strip-cropping, or terraces is needed to help control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary in places to intercept the runoff. Chiseling to a depth of more than 10 inches is needed in places every crop year to break up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses and legumes in the rotation help to control erosion and to maintain tilth. When a crop of grass or legumes is plowed out, the plow furrow should be turned uphill.

Grain and grasses respond to nitrogen fertilizers, and legumes respond to sulfur fertilizers.

CAPABILITY UNIT IVe-8

This unit consists of well drained Larkin, Schumacher, and Tekoa soils. These soils are 20 to more than

60 inches deep. Slopes range from 3 to 25 percent. Permeability is moderate or moderately slow, and the available water capacity is moderate or high. Generally, surface runoff is slow to medium and the erosion hazard is slight to moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 100 to 130 days.

These soils can be cropped annually. Wheat, barley, peas, lentils, alfalfa, and grass are the principal crops. They are commonly grown in a wheat-peas or lentil rotation.

A suitable rotation is 3 years or more of grass and legumes and 4 years of wheat-peas or lentils or 4 years of annual grains. Other suitable rotations are wheat-peas or lentils, wheat-barley-peas or lentils, annual grain, or grass for seed. These soils can be farmed under these rotations without excessive erosion if crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface layer is rough and cloddy during winter; a winter cover crop is grown or stubble is left standing; waterways are properly shaped, packed, and seeded to grass; tillage and seeding are across the slope or on the contour; and fall grain is seeded early enough to provide winter cover. Chiseling to a depth of more than 10 inches in fall breaks up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring. Use of strip-cropping, divided slopes, or diversions is needed to help control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from these soils, diversions are necessary to intercept runoff.

Snow drifting is common on these soils. It smothers fall-seeded grain, permits weed invasion, and causes excessive rill erosion when the snow melts in spring. Snow drifting can be reduced by leaving stubble on hilltops and on the upper part of the adjacent south- and west-facing slopes and by planting a windbreak of trees to intercept the snow before it reaches these soils.

CAPABILITY UNIT IVe-9

Only Walvan silt loam, 7 to 25 percent slopes, is in this unit. This soil is more than 60 inches deep. It is well drained. Permeability is moderate, and the available water capacity is high. Generally, surface runoff is medium and the hazard of erosion is moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The hazard of soil blowing is severe. The annual precipitation ranges from 12 to 15 inches. The frost-free season is 130 to 150 days.

Wheat, alfalfa, and grass are the principal crops. This soil is commonly cropped in a wheat-fallow rotation.

This soil can be farmed in a crop rotation of 4 years of wheat-fallow followed by 9 years of alfalfa, grass, or both. This can be done without excessive erosion if crop residue is mixed into the tillage layer, maximum residue of straw is left on the surface at seeding time, the surface is rough and cloddy during winter, tillage is minimal and on the contour or across the slope, and fall grain is seeded early enough to provide winter cover.

Divided slopes, strip-cropping, or terraces are needed

to help to control erosion on long slopes that have no grass or legume cover. If steeper soils are upslope from this soil, diversions are necessary in places to intercept runoff. Chiseling to a depth of more than 10 inches is needed in places every crop year to break up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When a crop of grasses and legumes is plowed out, the plow furrow should be turned uphill.

Grain and grasses respond to nitrogen fertilizers, and alfalfa responds to sulfur fertilizers.

CAPABILITY UNIT IVe-10

This unit consists of well drained Garfield, Naff, Palouse, and Staley soils. The Naff soil is in complex with the Garfield soils. These soils are more than 60 inches deep. Slopes range from 3 to 25 percent. Permeability is slow to moderate, and the available water capacity is high. Generally, surface runoff is slow to medium and the erosion hazard is slight to moderate. If the ground is frozen, runoff is very rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 18 to 23 inches. The frost-free season is 110 to 140 days.

These soils can be cropped annually. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops. They are commonly grown in a wheat-peas or lentils rotation or a wheat-fallow rotation.

These soils can be farmed in a rotation of annual grain or of annual grain for 4 years followed by alfalfa, grass, or both for 4 years. This can be done without excessive erosion if waterways are properly shaped, packed, and seeded to grass; all crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; tillage is minimal and on the contour or across the slope; and fall grain is seeded early enough to provide winter cover. Chiseling to a depth of more than 10 inches is needed in places to break up the tillage pan. Chisel spacing of more than 18 inches is suitable. Chiseling allows deeper penetration of moisture during winter and reduces runoff in spring. Divided slopes are needed to help control erosion on long slopes that have no grass or legume cover. Hilltop or ridgetop seedings of grass and legumes protect slopes from snow drifting and from runoff.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When a crop of grasses and legumes is plowed out, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IVe-11

Only Spofford silt loam, 0 to 15 percent slopes, is in this unit. This soil is 60 inches deep. It is moderately well drained. Permeability is slow, and the available water capacity is moderately high. Generally, surface runoff is very slow to medium and the erosion hazard is slight to moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges

from 14 to 18 inches. The frost-free season is 130 to 145 days.

Wheat, barley, alfalfa, and grass are the principal crops. This soil is commonly cropped in a wheat-fallow rotation.

This soil can be farmed in a rotation of wheat-barley-fallow for 3 years, and alfalfa-grass for 3 years. This can be done without excessive erosion if waterways are shaped, packed, and seeded to grass; all crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; tillage is minimal and on the contour or across the slope; and fall grain is seeded early enough to provide winter cover. Use of divided slopes, strip cropping, or terraces is needed to help control erosion on long slopes that have no grass or legume cover. Chiseling to a depth of more than 10 inches is needed to break up the tillage pan. It also allows deeper penetration of moisture in spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When a crop of grass and alfalfa is plowed out, the plow furrow should be turned uphill.

Grain and grasses respond to nitrogen fertilizers, and legumes respond to sulfur fertilizers.

CAPABILITY UNIT IVe-12

Only Tucannon silt loam, 7 to 25 percent slopes, is in this unit. This soil is 20 to 40 inches deep to basalt bedrock. It is well drained. Permeability is moderate, and the available water capacity is moderate to moderately high. Generally, surface runoff is medium and the erosion hazard is moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 16 to 23 inches. The frost-free season is 110 to 130 days.

This soil can be cropped annually. Wheat, barley, peas, lentils, grass, and alfalfa are the principal crops.

This soil can be farmed in a 3-year wheat-barley-peas or lentils rotation followed by a 6-year rotation of alfalfa, grass, or both. This can be done without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; tillage is minimal and on the contour or across slope; and fall grain is seeded early enough to provide winter cover. Use of divided slopes and strip cropping is needed to help control erosion on long slopes that have no grass or legume cover. If steep soils are upslope from this soil, diversions are necessary in places to intercept runoff. Chiseling to a depth of 10 inches or more is necessary in places to break up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When a crop of grass or legumes is plowed out, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IVe-13

Only Asotin silt loam, 7 to 25 percent slopes, is in this unit. This soil is 20 to 40 inches deep to basalt. It is well drained. Permeability is moderate, and the available water capacity is moderately high. Generally, surface runoff is medium and the erosion hazard is moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 12 to 15 inches. The frost-free season is 135 to 160 days.

Wheat, barley, alfalfa, and grass are the principal crops.

This soil can be farmed in a wheat-barley-fallow or hay and pasture rotation without excessive erosion if waterways are properly shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; tillage is minimal and on the contour or across the slope; and fall grain is seeded early enough to provide winter cover. Use of strip cropping, divided slopes, and runoff interception and water disposal structures is suitable for some sites. Chiseling to a depth of more than 10 inches is needed in places every other year to break up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses and legumes in the rotation help to control erosion and to maintain or improve tilth. When a crop of grass or legumes is plowed out, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IVe-14

Only Almot silt loam, 7 to 25 percent slopes, is in this unit. This soil is 20 to 40 inches deep to basalt bedrock. It is well drained. Permeability is moderate, and the available water capacity is moderate or moderately high. Generally, surface runoff is medium and the erosion hazard is moderate. If the ground is frozen, runoff is rapid and the erosion hazard is severe during rainfall or when snow melts. The annual precipitation ranges from 15 to 18 inches. The frost-free season is 130 to 140 days.

Wheat, barley, alfalfa, and grass are the principal crops. This soil is commonly cropped in a wheat-fallow rotation.

This soil can be farmed in a crop rotation of wheat-barley-fallow, annual grain, or 2 years of annual grain followed by 6 years of alfalfa, grass, or both. This can be done without excessive erosion if waterways are shaped, packed, and seeded to grass; crop residue is mixed into the tillage layer; maximum residue of straw is left on the surface at seeding time; the surface is rough and cloddy during winter; tillage is minimal and on the contour or across the slope; and fall grain is seeded early enough to provide winter cover. Use of strip cropping, divided slopes, and runoff interception and water disposal structures is suitable for some sites. Chiseling to a depth of more than 10 inches is necessary in places every other year to break up the tillage pan. It also allows deeper penetration of moisture during winter and reduces runoff in spring.

Grasses or legumes in the rotation help to control erosion and to maintain or improve tilth. When a crop of grass or legumes is plowed out, the plow furrow should be turned uphill.

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

CAPABILITY UNIT IVw-1

Only Konert silty clay loam is in this unit. This soil is more than 60 inches deep. Slopes range from 0 to 3 percent. This soil is somewhat poorly drained. Permeability is slow, and the available water capacity is high. Surface runoff is very slow, and there is little or no erosion hazard. In many places runoff is ponded. Some areas are subject to overflow and deposition. Tillage is delayed in spring because of wetness. The annual precipitation ranges from 20 to 23 inches. The frost-free season is 90 to 110 days.

This soil can be cropped annually. Wheat, barley, grass, and legumes are the principal crops. They are commonly grown in a rotation of annual grain or hay or pasture. Grass is grown for seed.

Good management for this soil includes shaping and packing waterways and seeding them to grass, mixing crop residue into the tillage layer, leaving maximum residue of straw on the surface at seeding time, and keeping the surface rough and cloddy during winter. Keeping stream channels free of debris helps to prevent overflow. If steeper soils are upslope from this soil, diversions are necessary in places to intercept the runoff. Chiseling to a depth of more than 10 inches every few years breaks up the tillage pan. Moldboard, disk, or chisel plowing after harvest when the soil is dry leaves the surface rough and cloddy through winter. Early fall seeding provides winter cover. In some years wheat is drowned out by water that ponds in depressions. Random tile drains or open ditches are needed in such places.

Grasses and legumes in the rotation help to maintain or improve tilth.

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

CAPABILITY UNIT IVw-2

Only Emdent silt loam, drained, is in this unit. This soil is 60 inches deep. Slopes range from 0 to 3 percent. This soil is alkaline, and it is somewhat poorly drained. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and there is little or no erosion hazard. In many places runoff water is ponded. Tillage is delayed in spring because of wetness. The annual precipitation ranges from 11 to 16 inches. The frost-free season is 135 to 145 days.

Wheat, barley, oats, grass, and legumes are the principal crops. This soil can be cropped annually.

Good management includes mixing all crop residue into the tillage layer, leaving maximum residue of straw on the surface at seeding time, and keeping the surface rough and cloddy during winter. Chiseling to a depth of more than 10 inches breaks up the tillage pan. Moldboard, disk, or chisel plowing after harvest when the soil is dry leaves the surface rough and cloddy during winter. Early fall seeding provides winter cover.

In some years winter wheat is drowned out by water that ponds in depressions. Random tile drains or open ditches are needed in areas that have proper outlets.

Grasses and legumes in the rotation help to maintain or improve tilth.

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

CAPABILITY UNIT VIe-1

This unit consists of well drained Almota, Asotin, Athena, Palouse, Roloff, Schumacher, Starbuck, Tekoa, and Walla Walla soils; somewhat excessively drained Magallon soils; and moderately well drained Thatuna soils. The Almota, Asotin, Magallon, Roloff, and Tekoa soils are 20 to 40 inches deep to bedrock, gravel, or sand. The Athena, Palouse, Schumacher, Thatuna, and Walla Walla soils are 40 to more than 60 inches deep to bedrock. The Starbuck soils are about 15 inches deep to bedrock. Slopes range from 0 to 65 percent. The annual precipitation ranges from 11 to 23 inches. The frost-free season is 100 to 160 days. Permeability ranges from moderately rapid to moderately slow, and the available water capacity ranges from low to high. Surface runoff is very slow to very rapid, and the erosion hazard is slight to very high.

These soils are suitable for grazing. A permanent grass cover helps to control erosion. Limiting cultivation to the establishment of grasses and legumes is needed on soils that have slopes of less than 40 percent.

CAPABILITY UNIT VIe-2

This unit consists of well drained Athena, Calouse, Lance, Palouse, Risbeck, and Walla Walla soils. These soils are more than 60 inches deep. The Calouse soils have lime at a depth of 20 to 40 inches, and the Lance and Risbeck soils have lime and lime-silica cemented lenses throughout the profile. Slopes are mostly 20 to 40 percent but range from 5 to 40 percent. Permeability is moderate to moderately slow, and the available water capacity is moderately high and high. The annual precipitation ranges from 12 to 23 inches. The frost-free season is 110 to 155 days. Surface runoff is medium to very rapid, and the erosion hazard is moderate to very high.

These soils are suitable for hay or pasture and for grazing. Most of these soils are eroded, have low production potential, and need permanent cover. Cultivation should be limited to the establishment of permanent cover.

CAPABILITY UNIT VIe-3

This unit consists of well drained Larkin and Tekoa soils. The Larkin soils are 40 to 60 inches or more deep to bedrock. Slopes range from 25 to 55 percent. Permeability is moderate to moderately slow, and the available water capacity is moderately high to high. The annual precipitation ranges from 20 to 23 inches. The frost-free season is 100 to 135 days. Surface runoff is rapid to very rapid, and the erosion hazard is high to very high.

These soils are used for woodland and limited grazing.

CAPABILITY UNIT VIIs-1

This unit consists of well drained Bakeoven, Cheney, Speigle, Tucannon, and Hesseltine soils. The Bakeoven and Tucannon soils in this capability unit are mapped in complex. The Cheney, Tucannon, and Hesseltine soils are 20 to 40 inches deep to bedrock or gravel. The Speigle soils are 40 to 60 inches or more deep, and the Bakeoven soils are 6 to 10 inches deep to bedrock. Slopes range from 0 to 30 percent. Permeability is moderate and moderately slow, and the available water capacity is low to high. Surface runoff is very slow to medium, and there is a moderate water erosion hazard or none. The annual precipitation ranges from 15 to 23 inches. The frost-free season is 110 to 155 days.

These soils are suitable for grazing. The Hesseltine and Speigle soils are used for woodland and limited grazing. A permanent cover helps to control erosion. Cultivation should be limited to the establishment of grasses in areas that need seeding.

CAPABILITY UNIT VIW-1

This unit consists of somewhat poorly drained Emdent and Pedigo soils. The Emdent soils are more than 60 inches deep, and the Pedigo soils are 40 to 60 inches deep to a cemented hardpan. Slopes range from 0 to 3 percent. Permeability is moderate to very slow, and the available water capacity is moderately high and high. These soils have a water table at a depth of 24 to 30 inches. Surface runoff is very slow, and there is little or no erosion hazard. The annual precipitation ranges from 11 to 18 inches. The frost-free season is 130 to 155 days.

Most areas of these soils are used for grazing. Areas that need reseeding can be cultivated and seeded to alkaline-tolerant grasses.

CAPABILITY UNIT VIIe-1

This unit consists of well drained Alpowa, Linville, Ritzville, and Starbuck soils. The Alpowa and Linville soils are 40 to more than 60 inches deep to bedrock, the Ritzville soils are more than 60 inches deep to bedrock, and the Starbuck soils are 10 to 20 inches deep to bedrock. Slopes range from 30 to 65 percent. Permeability is moderate, and the available water capacity is low to high. Surface runoff is rapid to very rapid, and the erosion hazard is high to very high. The annual precipitation ranges from 11 to 20 inches. The frost-free season is 110 to 160 days.

These soils are suitable for grazing. In areas where slopes are less than 40 percent and where the range is in poor condition, range seeding is practical.

CAPABILITY UNIT VIIe-1

This unit consists of well drained Alpowa, Anders, Asotin, Bakeoven, Benge, Gwin, Kuhl, Linville, Speigle, Stratford, and Tucannon soils. The Anders, Asotin, Benge, Stratford, and Tucannon soils are 20 to 40 inches deep to bedrock or gravel. The Bakeoven soils are 6 to 10 inches deep to bedrock, and the Gwin and Kuhl soils are 10 to 20 inches deep to bedrock. The Alpowa, Linville, and Speigle soils are 40 to 60 inches deep or more to bedrock. Permeability is moderate or moderately slow, and the available water capacity is low to high. Slopes are 0 to 65 percent. Surface runoff is very slow to very rapid, and the erosion hazard

is slight to very high. The annual precipitation ranges from 11 to 23 inches. The frost-free season is 110 to 160 days.

These soils are suitable for grazing. The Speigle soils are also used for woodland. In some areas where slopes are less than 40 percent and where the range is in poor condition, range seeding is practical.

CAPABILITY UNIT VIIIs-1

This unit consists of Rock outcrop and Rock outcrop-Lithic Xerorthents complex. These miscellaneous areas are on side slopes along major drainageways and in channeled scablands. Rock outcrop is essentially barren land, or it supports a sparse stand of vegetation in rock fractures. Lithic Xerorthents are 5 to 12 inches deep over bedrock and are mapped in complex with Rock outcrop. They provide limited grazing in early spring.

Rock outcrop and Lithic Xerorthents are used for wildlife habitat, recreational areas, limited grazing, and esthetic purposes.

CAPABILITY UNIT VIIIw-1

This unit consists of Riverwash and Xerofluvents. These miscellaneous areas are along the Snake and Palouse Rivers and their drainageways. Riverwash consists of areas of coarse sand, gravel, and cobblestones that are generally less than 3 feet above the normal level of streams. Xerofluvents consists of areas of soils that formed in cobbly alluvium on bottom land, terraces, and alluvial fans that are generally 4 to more than 6 feet above the normal level of streams. Areas of Riverwash are subject to change in size and shape even during normal stream flow. Xerofluvents are subject to flooding.

Riverwash and Xerofluvents are used for wildlife habitat and for recreational and esthetic purposes.

Estimated yields

The per acre average yields that can be expected of the principal crops under a high level of management are shown in table 2. In any given year, yields may be higher or lower than those indicated in table 2, because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

The predicted yields are based mainly on the experience and records of farmers, conservationists, and Extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The latest crop management and soil practices used by many farmers in the county are assumed in predicting the yields. Hay and pasture yields are predicted for varieties of grasses and legumes suited to the soil. A few farmers may be using more advanced practices and are obtaining average yields higher than those shown in table 2.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; proper planting and seeding rates; suitable high-yielding crop

varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

Range

Approximately 227,900 acres, or about 16 percent, of Whitman County is range. Soils used for range are generally those that are unsuited to crops and too dry to support trees. Many of the farms include areas of soils that are better suited to range than to other uses.

Soils that have the capacity to produce the same kinds, amounts, and proportions of range plants are grouped into range sites. A range site is the product of all environmental factors responsible for its development.

A plant community existing within a range site that has not undergone abnormal disturbance is the potential, or climax, plant community for that site. Climax plant communities are not precise or fixed in their composition but vary, within reasonable limits, from year to year and from place to place.

Abnormal disturbance such as overuse by livestock, excessive burning, erosion, or plowing results in changes in the climax plant community or even complete destruction if the disturbance is drastic enough. When the range site has not deteriorated significantly under such disturbance, secondary plant succession progresses in the direction of the natural potential or climax plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in excellent condition if 76 to 100 percent of the vegetation is the same kind as that in the climax. It is in good condition if the percentage is 51 to 75; fair, if the percentage is 26 to 50; and poor, if the percentage is 25 or less.

When changes occur in the climax plant community due to livestock use or disturbance, some plant species will increase and others will decrease. Species increasing or decreasing depends upon the grazing animal, season of use, and the degree of utilization. By comparing the composition of the present plant community to the potential plant community, it is possible to see how individual species have increased while others have decreased. Plants that are absent in the climax community but which show up in the present plant community are invaders for the site.

The composition of climax and present plant communities, with other range site information, provides the basis for selecting range management.

Management on rangeland generally tries to increase desirable plants and restore rangeland to as near

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climax conditions as possible. Some programs are designed to create or maintain plant communities somewhat removed from the climax to fit specific needs in the grazing program, to provide wildlife habitat, or for other benefits. Any management objective should be compatible with conservation objectives.

Total production refers to the amount of vegetation that can be expected from a well managed range that is supporting the potential plant community. It is expressed in pounds per acre of air-dry vegetation for favorable and unfavorable years. A favorable year is one in which the amount and distribution of precipitation and the temperatures result in growing conditions substantially better than average; an unfavorable year is one in which growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential plant community. All vegetation, that which is highly palatable to livestock and that which is unpalatable, is included. Some of the vegetation also may be grazed extensively by wildlife, and some of it may not.

The range site for soils can be determined by referring to the last paragraph of the appropriate mapping unit in the section "Descriptions of the Soils." The range sites of Whitman County are described in the following pages.

ALKALI RANGE SITE

This range site consists of somewhat poorly drained, moderately permeable soils. It covers about 6,700 acres. These soils are affected by saline or alkali salts, or both, and by flooding, ponding, and a water table at a depth of 21/2 to 4 feet. Some soils have a hardpan below a depth of 40 inches and are very slowly permeable. Elevation ranges from 900 to 2,200 feet.

The annual precipitation is 11 to 18 inches. Most of it is received between October 1 and June 1. Additional moisture is generally available because of the bottom land position of this site. The summers are hot and dry. Plant growth is limited by the high salt content of the soils. The period between May 1 and August 1 is favorable for plant growth.

The potential plant community is characterized by grasses. Giant wildrye makes up 50 percent of the air-dry herbage, and saltgrass makes up 25 percent. The rest of the plant community is alkali bluegrass, alkali cordgrass, foxtail barley, rushes, sedges, potentilla, yarrow, iris, greasewood, and rabbitbrush.

If the site is in excellent condition, the total annual forage production is about 4,000 pounds per acre when growing conditions are favorable and 2,000 pounds per acre when growing conditions are poor. About 95 percent of the annual production is plants that produce forage for livestock. Where adjacent to open water, this site provides excellent nesting for ringneck pheasants and waterfowl.

Giant wildrye decreases rapidly with continued overgrazing, repeated burning, or mowing. Saltgrass, alkali cordgrass, potentilla, yarrow, and rabbitbrush increase as the giant wildrye is killed out. Weedy plants such as bassia, lambsquarter, and dandelion become established with continued abuse of the site.

Range seeding to tall wheatgrass is desirable where

the giant wildrye has been destroyed. A good summer fallow seedbed is essential. A drill with deep furrow openers is suitable for seedling establishment. Salts are less concentrated in the furrow bottoms.

LOAMY RANGE SITE (L-2)

This range site consists of well drained and somewhat excessively drained, moderately permeable and moderately slowly permeable silt loams, cobbly silt loams, very cobbly silt loams, loams, very cobbly loams, very fine sandy loams, and sandy loams. It covers about 77,200 acres of upland terraces, outwash plains, canyon sides, and foot slopes. The available water capacity is moderate to high. Some soils have a hardpan at a depth of 20 to 40 inches. Slopes are mostly 7 to 25 percent but range from 0 to 40 percent. Elevation ranges from 500 to 2,500 feet.

The annual precipitation is 11 to 15 inches. About 80 percent of this moisture is received between October 1 and June 1. The summers are hot and dry. The period between April 1 and June 15 is favorable for plant growth.

The potential plant community is characterized by grasses. Bluebunch wheatgrass makes up 50 percent of the vegetation, by weight, and Idaho fescue makes up 20 percent. The rest of the plant community is Sandberg bluegrass, prairie junegrass, threadleaf sedge, giant wildrye, Thurber needlegrass, big bluegrass, wild buckwheat, gromwell, arrowleaf balsamroot, fleabane, lupine, milkvetch, yarrow, hawksbeard, phlox, rabbitbrush, annual forbs, and grasses.

If this site is in excellent condition, the total annual forage production is about 1,400 pounds per acre when growing conditions are favorable and 700 pounds per acre in years when growing conditions are poor. About 90 percent of the annual production is from plants that produce forage for cattle, sheep, and horses. This site is well suited to grazing in spring, fall, and winter. Deer use this site for grazing in winter and early spring, and chukar use steep, rocky areas of it as habitat.

Bluebunch wheatgrass, Idaho fescue, big bluegrass, giant wildrye, prairie junegrass, and Thurber needlegrass decrease with continued overgrazing. As these plants decrease, threadleaf sedge, Sandberg bluegrass, lupine, and rabbitbrush increase. Undesirable weeds and annuals such as cheatgrass brome, medusahead, ripgut brome, plantain, Jim Hill and tansey mustards, tarweed, thistles, and common mullein become more abundant as the range deteriorates.

Range seeding is needed if the site is in poor condition. Most soils in this site are suitable for mechanical seedbed preparation. Perennial grasses and legumes can be seeded with regular grain drills. Selection of grasses to help balance seasonal forage shortages is important for soil stabilization and for animal production.

LOAMY RANGE SITE (L-3)

This range site includes well drained, moderately permeable to moderately slowly permeable silt loams or very cobbly silt loams. It covers about 28,000 acres of upland hills, ridges, side slopes, and foot slopes. The soils are 20 inches to more than 60 inches deep to bedrock. The available water capacity is mostly mod-

erate to moderately high. Slopes are mostly 0 to 30 percent but range from 0 to 55 percent. Generally, these soils are on south- and -west-facing side slopes.

The annual precipitation is 14 to 23 inches. About 80 percent of this moisture is received between October 1 and June 15. The summers are hot and dry. The period between May 1 and July 15 is favorable for plant growth.

The potential plant community is characterized by scattered ponderosa pine and hawthorne and an understory of grasses, forbs, and shrubs. Idaho fescue makes up 35 percent, by weight, and bluebunch wheatgrass makes up 35 percent. The rest of the plant community is Sandberg, Kentucky, Canada, and big bluegrass, annual grasses, arrowleaf balsamroot, lupine, biscuitroot, milkvetch, wild buckwheat, fleabane, yarrow, clover, arnica, potentilla, geranium, annual forbs, snowberry, rose, threetip sagebrush, and rabbitbrush.

If this site is in excellent condition, the total annual forage production is about 2,400 pounds per acre when growing conditions are favorable and 1,090 pounds per acre when growing conditions are poor. About 85 percent of the annual production is from plants that produce forage for cattle and horses. This site is suitable for grazing in late spring, summer, and fall. It also provides habitat for deer, partridge, quail, rabbits, and coyotes.

Idaho fescue and bluebunch wheatgrass decrease with continued overgrazing or repeated burning. As those plants decrease, less productive bluegrasses, lupine, wild buckwheat, potentilla, snowberry, and rabbitbrush increase. Thistles, medusahead, yellow starthistle, and other annual grasses and weeds become abundant when the site is badly depleted.

Range seeding is needed if the site is in poor condition. A summer fallow seedbed is suitable, but fall plowing and spring planting are often used, depending on the degree of elimination of competing vegetation.

Selecting plants for seedings to help balance seasonal forage shortages are important for soil stabilization and for livestock or wildlife requirements.

NORTH EXPOSURE RANGE SITE (N-1)

This range site consists of well drained, moderately steep and very steep, moderately permeable, cobbly silt loams and silt loams. It covers about 24,000 acres. The soils are on north- and northeast-facing upland hills, ridges, and side slopes. They are 20 to more than 60 inches deep to bedrock. The available water capacity is moderate to high. Elevation ranges from 600 to 2,500 feet.

The annual precipitation is 11 to 16 inches. About 80 percent of this moisture is received between October 1 and June 1. Snow blown from adjacent ridgetops accumulates on the north- and northeast-facing slopes and adds to the moisture supply. The cooler temperature of the soils and the protection they receive from wind reduce the loss of moisture by evaporation. The summers are hot and dry. The period between April 15 and July 1 is favorable for plant growth.

The potential plant community is characterized by an overstory of threetip sagebrush and rabbitbrush and an understory of grasses and forbs. Idaho fescue makes up 45 percent, by weight, of the total annual herbage production; bluebunch wheatgrass makes up 35 per-

cent; Sandberg bluegrass, prairie junegrass, and threadleaf sedge make up 8 percent; and arrowleaf balsamroot, lupine, wild buckwheat, milkvetch, and yarrow make up 7 percent. The rest of the plant community is rabbitbrush and threetip sagebrush.

If the site is in excellent condition, the total annual forage production is about 1,600 pounds per acre when growing conditions are favorable and 750 pounds per acre when growing conditions are unfavorable. About 85 percent of the annual production is from plants that produce forage for domestic livestock. This site is suitable for grazing in late spring, early summer, and fall. It is used by wildlife throughout the year.

Idaho fescue and bluebunch wheatgrass decrease with continued overgrazing or repeated burning; Sandberg bluegrass, wild buckwheat, lupine, milkvetch, yarrow, and rabbitbrush increase. Undesirable grasses and weeds, cheatgrass brome, medusahead, yellow starthistle, and annual plantain are common invaders when the vegetation is in poor condition.

Range seeding is suitable in areas that are in poor condition and on slopes where equipment can be used. Seedings of grasses and legumes that provide forage for the desired period of use and that help to control erosion are suitable.

NORTH EXPOSURE RANGE SITE (N-2)

This range site consists of well drained, moderately steep to very steep, moderately permeable silt loams. It covers about 8,700 acres. The soils are on upland north- and east-facing sides of major drainage-ways, mostly in the southeastern part of the county. Slopes are 25 to 65 percent. The available water capacity is moderately high or high. Elevation ranges from 1,100 to 2,600 feet.

The annual precipitation is 15 to 20 inches. About 80 percent of this moisture is received between October 1 and June 1. Snow blown from adjacent ridgetops accumulates on north-facing slopes and adds to the moisture supply. The cooler temperature of the soils and the protection they receive from wind reduce the loss of moisture by evaporation. The summers are warm and dry. The period between May 10 and July 30 is favorable for plant growth.

The potential plant community is characterized by a shrubby overstory and an understory of grasses and forbs. Idaho fescue makes up 70 percent, by weight, of the vegetation, and bluebunch wheatgrass and Sandberg bluegrass each make up 5 percent. The rest of the plant community is mainly Columbia needlegrass, prairie junegrass, big bluegrass, elk sedge, potentilla, fleabane, arrowleaf balsamroot, yarrow, lupine, phlox, wild buckwheat, milkvetch, and annual grasses and weeds and an overstory of rose, snowberry, currant, serviceberry, and hawthorn.

If this site is in excellent condition, the total annual forage production is about 2,000 pounds per acre when growing conditions are favorable and 1,500 pounds per acre when growing conditions are unfavorable. About 85 percent of the annual production is from plants that produce forage for livestock. This site is suitable for grazing in late spring, summer, and fall. It provides habitat for big game and other wildlife species throughout the year.

Idaho fescue, bluebunch wheatgrass, big bluegrass,

and elk sedge decrease with continued overgrazing or repeated burning; Sandberg bluegrass, Kentucky bluegrass, arrowleaf balsamroot, lupine, yarrow, wild buckwheat, phlox, milkvetch, rabbitbrush, rose, snowberry, currant, serviceberry, and hawthorn increase. Weedy plants such as medusahead, annual bromes, yellow starthistle, and goatweed invade when the site is in poor condition.

Range seeding is suitable when this site is in poor condition and where slopes permit use of equipment. Seeding of grasses that provide forage for the desired period of use and that help to control soil erosion is suitable.

NORTH EXPOSURE RANGE SITE (N-3)

This range site consists of well drained and moderately well drained, moderately permeable and moderately slowly permeable silt loams. It covers about 1,200 acres of loess uplands, mostly in the eastern part of the county. Available water capacity is high. Slopes are 40 to 55 percent. Exposures are north and east. Elevation ranges from 2,000 to 3,000 feet.

The annual precipitation is 18 to 23 inches. About 80 percent of this moisture is received between October 1 and June 1. Snow blown from adjacent ridgetops accumulates on the north- and east-facing side slopes and adds to the moisture supply. Protection from wind and the cooler temperature of the soils reduce the loss of moisture by evaporation and thus lengthen the growing season. The summers are warm and dry. The period between May 15 and July 30 is favorable for the growth of plants.

The potential plant community is characterized by a shrubby overstory and an understory of grasses and forbs. Idaho fescue makes up 45 percent of the vegetation, by weight; bluebunch wheatgrass makes up 30 percent; snowberry makes up 10 percent; and rose and spirea make up 5 percent each. The rest of the plant community is Sandberg, Kentucky, and big bluegrasses, timothy, pinegrass, elk sedge, arrowleaf balsamroot, potentilla, lupine, geranium, wild buckwheat, milkvetch, strawberry, yarrow, aster, snowberry, ninebark, hawthorn, willow, and a few ponderosa pine.

If this site is in excellent condition, the total annual forage production is about 2,600 pounds per acre in years when growing conditions are favorable and 2,000 pounds per acre in years when growing conditions are unfavorable. About 75 percent of the annual production is from plants that produce forage for livestock. This site is suitable for grazing livestock in summer and fall and for wildlife habitat throughout the year. The shrub species are important to deer and other wildlife species.

Idaho fescue, bluebunch wheatgrass, elk sedge, pinegrass, and big bluegrass decrease with continued overgrazing or repeated burning. Kentucky and Sandberg bluegrasses, arrowleaf balsamroot, potentilla, lupine, wild buckwheat, yarrow, snowberry, spirea, and ninebark increase when the range is abused. When this site is in poor condition, weedy plants, cheatgrass brome, soft chess, medusahead, goatweed, yellow starthistle, thistle, common mullein, and rabbitbrush invade as climax plants are killed out.

Range seeding is suitable in areas that are in poor condition and on slopes where conventional equipment

can be used. Consideration should be given to leaving key areas of brush cover for wildlife and watershed protection along drainageways and on steep hillsides. Grasses and legumes selected for seeding should provide forage for livestock and big game during periods of low forage supply and should help to control soil erosion.

SANDY LOAM RANGE SITE

This range site consists of somewhat excessively drained, nearly level to steep, moderately permeable or moderately rapidly permeable sandy loams that are underlain by coarse or very coarse sand below a depth of 20 to 40 inches. It covers about 2,600 acres of terraces and terrace breaks in channeled scablands along major drainageways. The available water capacity is low to moderately high. Slopes are mostly south- and southwest-facing and are 0 to 40 percent. Elevation ranges from 600 to 2,000 feet.

The annual precipitation is 11 to 15 inches. Most of this moisture is received between October 1 and May 1. Because of the low to moderately high available water capacity and the moderate and moderately rapid permeability, some moisture is lost through percolation and evaporation. The summers are hot and dry. The period between March 15 and June 15 is favorable for plant growth.

The potential plant community is characterized by scattered shrubs and an understory of grasses and forbs. Bluebunch wheatgrass makes up 50 percent of the vegetation, by weight. The rest of the plant community is 20 percent needleandthread; 5 percent Thurber needlegrass; 5 percent Sandberg bluegrass; and 5 percent prairie junegrass, Indian ricegrass, Idaho fescue, and annual grasses. Forbs make up 10 percent and consist of hawksbeard, biscuitroot, arrowleaf balsamroot, wild buckwheat, milkvetch, and annual forbs. Shrubs make up 5 percent and consist of rabbitbrush, big sagebrush, and bitterbrush.

If this site is in excellent condition, the total annual forage production is about 1,000 pounds per acre when growing conditions are favorable and 400 pounds per acre when growing conditions are unfavorable. About 90 percent of the annual production is from plants that produce forage for cattle, sheep, deer, and horses. This site is suitable for grazing in late fall, in winter, and in early spring. The soil tends to be loose and sandy, and it is not suitable for grazing during the dry summer.

Bluebunch wheatgrass, Idaho fescue, prairie junegrass, Indian ricegrass, Thurber needlegrass, hawksbeard, biscuitroot, and bitterbrush decrease with continued overgrazing or repeated burning; Sandberg bluegrass, needleandthread, arrowleaf balsamroot, wild buckwheat, milkvetch, lupine, phlox, and rabbitbrush increase. Undesirable weeds such as cheatgrass brome, cocklebur, china lettuce, Russian thistle, mustard, medusahead, and yellow starthistle invade the site if the range is in poor condition.

If the site is in poor condition, range seeding and minimal cultivation are needed.

SHALLOW RANGE SITE (S-2)

This range site consists of well drained, nearly level to very steep, moderately permeable cobbly silt loams

that are 10 to 20 inches deep to basalt. It covers about 60,000 acres of channeled scablands and side slopes along major drainageways. The available water capacity is low. Slopes are mostly west- and south-facing and are 0 to 65 percent. Areas of Rock outcrop are common. Elevation ranges from 600 to 2,600 feet.

The annual precipitation is 11 to 15 inches. About 80 percent of this moisture is received between October 1 and June 1. This site is dry, and plant growth is limited by the shallowness of the soil and the loss of moisture through evaporation. The summers are hot and dry. The period between April 1 and June 1 is favorable for plant growth.

The potential plant community is characterized by sparse patchy grasses, forbs, and few shrubs. Bluebunch wheatgrass makes up 65 percent of the vegetation, by weight, and Sandberg bluegrass makes up 10 percent. The rest of the plant community is Thurber needlegrass, arrowleaf balsamroot, biscuitroot, fleabane, lupine, yarrow, phlox, wild buckwheat, and rabbitbrush.

If this site is in excellent condition, the total annual forage production is about 700 pounds per acre when growing conditions are favorable and 400 pounds per acre when growing conditions are unfavorable. About 90 percent of the annual production is from plants that produce forage for cattle, sheep, and horses and occasionally for deer. The site is suitable for grazing in spring, fall, and winter. Grazing animals must be periodically excluded during plant growth to maintain or improve range vegetation. This site provides habitat for chukars.

Bluebunch wheatgrass decreases with continued overgrazing or repeated burning. Sandberg bluegrass, Thurber needlegrass, biscuitroot, and rabbitbrush increase. Undesirable weeds and annual grasses such as cheatgrass brome, medusahead, and yellow starthistle invade the site as the potential plant community deteriorates.

Soils in this site are too stony, steep, and shallow for range seeding. Vegetation improvement is slow but can be obtained through good range management.

SHALLOW RANGE SITE (S-3)

This range site consists of well drained, nearly level to very steep, moderately slowly permeable cobbly silt loams that are 20 to 40 inches deep over bedrock. It covers about 6,400 acres of uplands along major drainageways in the eastern part of the county. The available water capacity is low. Slopes are mostly 30 to 65 percent but range from 3 to 65 percent, and they face south and west. Elevation ranges from 1,600 to 3,000 feet.

The annual precipitation is 18 to 23 inches. About 80 percent of this moisture is received between October 1 and June 30. This site is droughty, and plant growth is limited by the shallowness and the low available water capacity of the soil. The summers are warm and dry. The period between May 1 and July 15 is favorable for plant growth.

The potential plant community is characterized by scattered shrubs and an understory of grasses and forbs. Bluebunch wheatgrass makes up 50 percent of the vegetation, by weight; Idaho fescue makes up 25 percent; and Sandberg, Kentucky, and Canada blue

grass make up 6 percent. The rest of the plant community is biscuitroot, arrowleaf balsamroot, lupine, wild buckwheat, milkvetch, yarrow, and fleabane. Shrubs are snowberry, threetip sagebrush, and rabbitbrush.

If this site is in excellent condition, the total annual herbage production is 1,200 pounds per acre when growing conditions are favorable and 550 pounds per acre when growing conditions are unfavorable. About 90 percent of the annual production is from plants that produce forage for cattle, horses, and deer. The site is suited to grazing livestock during spring or fall. It provides habitat for chukar.

Bluebunch wheatgrass and Idaho fescue decrease with continued overgrazing or repeated burning; Sandberg bluegrass, arrowleaf balsamroot, biscuitroot, lupine, and wild buckwheat increase. Undesirable plants such as cheatgrass brome, Japanese brome, medusahead, thistle, yellow starthistle, and rabbitbrush invade the site if the range deteriorates.

Range seeding is difficult because the soils are too shallow and stony.

VERY SHALLOW RANGE SITE

This range site consists of well drained, nearly level to moderately steep, moderately slowly permeable cobbly loams that are 6 to 10 inches deep over bedrock. It covers about 8,600 acres of channeled scablands and side slopes of major drainageways. Slopes face mostly south and west and are 0 to 30 percent. Elevation ranges from 600 to 2,600 feet.

The annual precipitation is 12 to 16 inches. Most of this moisture is received between October 1 and June 1. The summers are hot and dry. The period between April 1 and May 15 is favorable for plant growth.

The potential plant community is characterized by low-growing shrubs, grasses, and forbs. Sandberg bluegrass makes up 50 percent of the vegetation, by weight; stiff sagebrush makes up 20 percent; and wild buckwheat makes up 15 percent. Bluebunch wheatgrass, Thurber needlegrass, squirreltail, and annual grasses make up 5 percent. Forbs make up 10 percent and consist of hooker and serrated balsamroot, fleabane, phlox, violet, and annual forbs.

If this site is in excellent condition the total annual forage production is about 300 pounds per acre when growing conditions are favorable and 175 pounds per acre when growing conditions are unfavorable. About 70 percent of the annual production is from plants that produce forage for cattle, sheep, deer, and horses. The site is suitable for grazing livestock early in spring and for game animals during winter and early spring. It provides habitat for chukar.

Sandberg bluegrass and stiff sagebrush decrease with continued overgrazing or repeated burning; Balsamroot, biscuitroot, fleabane, and phlox increase. Undesirable weeds and annuals invade the site if the range deteriorates.

Range seeding is not practical because the soil is too shallow and stony and the potential yield is too low.

WET MEADOW RANGE SITE

This range site consists of somewhat poorly drained, moderately permeable to very slowly permeable silt loams and silty clay loams. It covers about 4,500 acres

of bottom lands. The available water capacity is high. The water table is at a depth of 6 to 60 inches, and the soils are subject to flooding in winter and spring. Elevation ranges from 1,500 to 2,800 feet.

The annual precipitation is 15 to 23 inches. Most of it is received between October 1 and June 15. Additional moisture is generally available because of the bottom land position of this site. The summers are hot and dry, but plant growth is not limited by lack of moisture. The period between May 1 and August 15 is favorable for plant growth.

The potential plant community is characterized by water-tolerant grasses, sedges, rushes, cattails, and a few willows. Tufted hairgrass makes up 30 percent of the air-dry herbage; reed canarygrass makes up 25 percent; reedtop makes up 10 percent; sedge makes up 5 percent; and rush, quackgrass, timothy, Kentucky bluegrass, foxtail barley, cattails, slender hairgrass, slender wheatgrass, meadow foxtail, and annual grasses make up 18 percent. Forbs make up 10 percent and consist of potentilla, mint, water buttercup, arrowgrass, and water hemlock. Shrubs make up 2 percent and consist of willow and aspen.

If the site is in excellent condition, the total annual forage production is about 6,000 pounds per acre when growing conditions are favorable and 3,000 pounds per acre when growing conditions are poor. About 95 percent of the annual production is from plants that produce forage for livestock. This range site provides excellent nesting cover for water birds.

Tufted hairgrass decreases rapidly with continued overgrazing, repeated burning, or mowing. Other plants that decrease are reed canarygrass, slender wheatgrass, timothy, and meadow foxtail. As these plants decrease, slender hairgrass, reedtop, sedge, foxtail barley, rushes, quackgrass, Kentucky bluegrass, arrowgrass, cattail, potentilla, mint, iris, buttercup, willows, and aspen increase. Weedy plants such as hairgrass, dock, fireweed, dandelion, bull thistle, and burdock, become established as the vegetation declines.

Range seeding to reed canarygrass is suitable where this range has deteriorated.

Woodland

About 10,000 acres, or less than 1 percent, of Whitman County is in woodland. The areas are privately owned. The important species is ponderosa pine with some Douglas-fir and western larch. The stands are generally unevenly aged. Logging is generally on a selective basis to a diameter limit and varies with the demand for stumpage. Logs are shipped to mills outside the survey area for processing.

Woodland in this survey area is also used for grazing, recreation, wildlife habitat, and watershed protection.

Table 3 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Mapping unit symbols for those soils suitable for wood crops are listed alphabetically by soil name, and the ordination symbol for each soil is given. All soils bearing the same ordination symbol require

ROBERT J. OLSON, woodland conservationist, Soil Conservation Service, assisted in preparing this section.

the same general kinds of woodland management and have about the same potential productivity.

The first part of the symbol, a number, indicates the potential productivity of the soils for important trees (4). The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates no significant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the order in which the letters are listed above-*x*, *w*, *t*, *d*, *c*, *s*, *f*, and *r*.

In table 3 the soils are also rated for a number of factors to be considered in management. The ratings of slight, moderate, and severe are used to indicate the degree of major soil limitations.

Ratings of the hazard of erosion indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small; *moderate* if some measures are needed to control erosion during logging and road construction; and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of equipment limitation reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or need for some modification in management or equipment; *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings when plant competition is not a limiting factor. The ratings are for seedlings from good planting stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of plant competition indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The potential productivity of merchantable trees on a soil is expressed as a site index. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number

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of years. The site index applies to fully stocked, even aged, unmanaged stands.

Trees to plant are those that are suitable for commercial wood production and that are suited to the soils.

Windbreaks and Environmental Plantings

Windbreaks are established to protect livestock, buildings, and yards from winds and snow. Windbreaks also help to protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of broad-leaved and coniferous species provide the most protection.

Narrow field windbreaks can be made at right angles to the prevailing wind on the windward side of the hillcrest. These prevent deep snowdrifts from forming on the steep, north-facing side slopes. Some of these slopes are planted to trees and shrubs to prevent slip-page and to decrease erosion.

Environmental plantings help to beautify and screen homes and other buildings and to abate surrounding noise. Healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 4 shows the height that locally adapted trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 4, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from the local office of the Soil Conservation Service or the Extension Service or from local nurserymen.

Wildlife Habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the development of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, wildlife will either be scarce or will not inhabit the area.

If the soils have potential, wildlife habitat can be created or improved by planting appropriate vegetation, by properly managing the existing plant cover,

IVAN L. LINES, JR., biologist, Soil Conservation Service, assisted in preparing this section.

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and by fostering the natural establishment of desirable plants.

In table 5 the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in: (1) planning the use of parks, wildlife refuges, nature study areas, and other developments for wildlife; (2) selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; (3) determining the intensity of management needed for each element of the habitat; and (4) determining areas that are suitable for acquisition to manage wildlife.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element or kind of wildlife habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element or kind of wildlife habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent

attention are required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and requires intensive effort. A rating of *very poor* means that restrictions for the element or kind of wildlife habitat are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. Examples are wheat, oats, barley, and peas. Major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Grasses and legumes are domestic grasses and herbaceous legumes that are planted for wildlife food and

cover. Examples are fescue, bluegrass, brome grass, orchardgrass, clover, alfalfa, sweetclover, and trefoil. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations.

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are wheatgrass, cheatgrass, fescue, sunflower, thistles, dandelions, and balsamroot. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, fir, cedar, and juniper. Major soil properties that affect the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Shrubs are bushy, woody plants that produce fruits, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Examples are willow, serviceberry, caragana, snowberry, sagebrush, rabbitbrush, and native roses. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that uses wetland as its habitat. Examples of wetland plants are smartweed, wild millet, rushes, sedges, burreed, and cattail. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness.

Shallow water areas are bodies of surface water that have an average depth of less than 5 feet and are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water control devices in marshes or streams. Examples are natural marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Open-land habitat consists of croplands, pastures, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, wild herbaceous plants, and shrubs. The kinds of wildlife attracted to these areas include California quail, mourning dove, pheasant, meadowlark, field sparrow, horned lark, killdeer, cottontail rabbit, rough-legged hawk, and red fox.

Woodland habitat consists of hardwoods or conifers

or a mixture of both, with an understory of grasses, legumes, and wild herbaceous plants. Examples of wildlife attracted to this habitat are thrushes, vireos, woodpeckers, squirrels, raccoons, and deer.

Wetland habitat consists of water-tolerant plants and shallow open water in marshes, wetlands, and sloughs. Examples of wildlife attracted to this habitat are ducks, geese, herons, shore-birds, kingfishers, beaver, muskrat, and mink.

Rangeland habitat consists of wild herbaceous plants and shrubs in range. Examples of wildlife attracted to this habitat are deer, chukar, Hungarian partridge, meadowlark, coyote, golden eagle, and ferruginous hawk.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction materials, and water management. Among those who can benefit from this section are engineers, landowners, community decision makers and planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in tables in this section are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by the soil survey and used in determining the ratings in this section are grain-size distribution, liquid limit, plasticity index, soil reaction, depth to and hardness of bedrock within 5 or 6 feet of the surface, soil wetness characteristics, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values may be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values may be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternate routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternate sites of

CHRISTIAN BAFUS, engineer, Soil Conservation Service, assisted in preparing this section.

location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations and testing.

The information is presented mainly in tables. Table 6 shows, for each kind of soil, ratings of the degree and kind of limitations for building site development; table 7, for sanitary facilities; and table 9, for water management. Table 8 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, with the soil map, soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have different meanings in soil science and in engineering; the Glossary defines many of these terms.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 6. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewer lines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness, of a high seasonal water table, the texture and consistence of soils, the tendency of soils to cave in or slough, and the presence of very firm, dense soil layers, bedrock,

or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, generally difficult to excavate, is indicated.

Dwellings and small commercial buildings, referred to in table 6, are built on undisturbed soil and have foundation loads of a dwelling no more than 3 stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation do not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets, referred to in table 6, have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load-supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic-supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones, all of which affect stability and ease of excavation, were also considered.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 7 shows the degree and kind of limitations of each soil for these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight*, soils are favorable for the specified use

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and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance are required.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect the absorption of the effluent are permeability, depth to a seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and as a result, ground water supplies in the area may be contaminated. Soils that have a hazard of inadequate filtration are indicated by footnotes in table 7.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoon areas are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet.

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Impervious soil at least 4 feet thick for the lagoon floor and sides is required to minimize seepage and contamination of local ground water. Soils that are very high in organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is solid waste (refuse) and soil material placed in successive layers, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability,

are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table 7 apply only to soil properties and features within a depth of about 6 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for sanitary landfills should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. Soils that are loamy

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or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material that is available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas such as slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 8 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construc

tion materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Roadfill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 11 provide more specific information about the nature of each horizon that can help determine its suitability for roadfill.

Soils rated *good* have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting

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features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*, regardless of the quality of the suitable material.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance for finding probable sources and are based on the probability that soils in a given area contain sizable quantities of sand and gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in the section "Engineering properties."

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to sustain the growth of plants. Also considered is the damage that would result to the area from which the topsoil is taken.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones, are low in content of gravel and other coarse fragments, and are gently sloping. They are low in soluble salts, which can limit plant growth. They are naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils; very firm clayey soils; soils with suitable layers less than 8 inches thick, soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is much preferred for topsoil because of its organic-matter

content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter. Consequently, careful preservation and use of material from these horizons are desirable.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 9 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or an embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping, and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability, texture, structure, depth -to claypan or other layers that influence rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of the root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments, or a combination of channels and ridges, constructed across a slope to intercept runoff and allow the water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness; depth to bedrock or other unfavorable material; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff at nonerosive velocities to outlets. Features that

affect the use of soils for waterways are slope, permeability, erodibility, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewer lines or capacity of the soil to absorb septic tank effluent. Soils that are subject to flooding are limited, in varying degree, to recreational use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreational facilities.

In table 10 the limitations of soils are rated as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by additional information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 7, and interpretations for dwellings without basements and for local roads and streets, given in table 6.

Camp areas require such site preparation as shaping and leveling tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. They are subject to heavy foot traffic and some vehicular traffic. The best soils for this use are mildly sloping and are neither wet nor subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are neither wet nor subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rain, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of

the soil over rock should be sufficient to allow necessary grading.

The design and layout of *paths and trails* for walking, horseback riding, and bicycling should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rain, are not dusty when dry, and are not subject to flooding more than once during the period of use. They should be moderately sloping and have few or no stones or boulders on the surface.

Soil Properties

Extensive data about soil properties collected during the soil survey are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of samples selected from representative soil profiles in the field.

When the soil scientist makes soil borings during field mapping, he can identify several important soil properties. He notes the seasonal soil moisture condition, or the presence of free water and its depth in the profile. For each horizon, he notes the thickness of the soil and its color; the texture, or the amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in place under the existing soil moisture conditions. He records the root depth of existing plants, determines soil pH or reaction, and identifies any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area. Also, pertinent soil and water features, engineering test data, and data obtained from laboratory analyses, both physical and chemical, are presented.

Engineering Properties

Table 11, gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a typical profile of each soil is indicated.

Texture is described in table 11 in standard terms used by the United States Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2

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millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified soil classification system (2, 5) and the American Association of State Highway and Transportation Officials (AASHTO) (1, 5) soil classification system. In table 11 soils in the survey area are classified according to both systems.

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and the organic-matter content. Soils are grouped into 15 classes-eight classes of coarse grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on

the borderline between two classes have a dual classification symbol, for example CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified as one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine grained soils. Highly organic soils are classified as A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The estimated classification, without group index numbers, is given in table 11.

Also in table 11 the percentage, by weight, of cobbles, or the rock fragments more than 3 inches in diameter,

are estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistency of soil. These indexes are used in both the Unified and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Physical and Chemical Properties

Table 12 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly soil structure, porosity, and gradation of texture—that influence the downward movement of water in the soil. Estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range of pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields

is largely affected by the quality of the irrigation water and the irrigation practices. Hence, the salinity of individual fields can differ greatly from the value given in table 12. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table 12, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly

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erodible, but crops can be grown if intensive measures to control soil blowing 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, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loamy that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loamy and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing 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, and 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, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and Water Features

Features that relate to runoff or infiltration of water, to flooding, to grading and excavation, and to frost action of each soil are indicated in table 13. This

information is helpful in planning land uses and engineering projects that are likely to be affected by the amount of runoff from watersheds, by flooding and a seasonal high water table, by the presence of bedrock or a cemented pan in the upper 5 or 6 feet of the soil, or by frost action.

Flooding is rated in general terms that describe the frequency, duration, and period of the year when flooding is most likely. The ratings are based on evidences in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; absence of distinctive soil horizons that form in soils of the area that are not subject to flooding; local information about floodwater heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods.

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

A *high water table* is the highest level of a saturated zone more than 6 inches thick in soils for a continuous period of more than 2 weeks during most years. The depth to high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the high water table; the kind of water table, whether perched,

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artesian, or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 or 6 feet or less. For many soils, limited range in depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and other observations during the soil mapping. The kind of bedrock and its relative hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200 horsepower tractor, but hard bedrock generally requires blasting.

Cemented pans are hard subsurface layers that are strongly compacted (indurated). Such pans cause difficulty in excavation. Hardness of pans is defined the same as hardness of bedrock.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action is defined as freezing temperatures in the soil and movement of soil moisture into the freezing zone,

which causes the formation of ice lenses. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly or sandy soils are the least susceptible.

Formation of the Soils

Soils are the products of soil-forming processes acting upon material deposited or accumulated by geologic agencies. The five factors that affect the formation of soils are parent material, relief, climate, living organisms, and time.

Parent Material

Soils in Whitman County formed in loess, volcanic ash, stream alluvium, glacial outwash, and colluvium and residuum from basalt and metasediments. Many differences in the soils are directly related to differences in parent material. Most of the soils are polygenetic in origin, however, and differences in properties and horizons are related in part to geomorphic history.

By HERMAN R. GENTRY. Based on his dissertation "Geomorphology of Some Selected Soil Landscapes in Whitman County, Washington," Washington State University, 1974. Assisting in the preparation of the dissertation were Warren A. Starr, Dr. Roald Fryxell, and Dr. Henry W. Smith.

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Relief

Most of the county is characterized by rolling loessal hills. Structure controls direction and gradient of westward flowing perennial streams. Streams that have incised the basalt plateau now meander through the loessal hills. The western part of the county consists of a network of channels known as "channeled scablands." A few buttes of metasediments that protrude through the basalt plateau are in the eastern part of the county. Along the northern margin are deep basaltic canyons referred to locally as the "Snake River Breaks." Elevation ranges from about 0-00 feet in the southwestern part of the county along the Snake River to 4,000 feet above sea level in the eastern part.

Climate

Climate is an active factor in soil formation. The primary climatic factors in soil formation are temperature and precipitation. Climate affects soil formation by its influence on weathering, organic matter production, and decomposition, leaching, erosion, and vegetation. It influences the kind and the density of the plants that grow in an area.

Annual precipitation ranges from about 11 inches in the southwestern part of the county to 23 inches in the northeastern part. Snow provides most of the winter precipitation. Rain and warm winds often melt the snow rapidly resulting in loss of moisture by runoff, especially if the soil is frozen near the surface. Usually more water is lost as the slope increases and less water is available for weathering and leaching of the soil.

The kind and degree of eluviation depends on the amount of water percolating through the soil under present and past climatic conditions. This is reflected by the characteristics of the soils in this area. Percolation is influenced by the amount of precipitation and evapotranspiration and by the length of the frost-free period. High evapotranspiration impedes leaching and in places causes upward movement of soluble salts. Frequent rainstorms that produce turbulent movement of water (saturated flow) through large pores and cracks aid in eluviation of clays. Alternating wet

and dry conditions cause cracks, also aiding eluviation of clays.

Summers are hot and dry in Whitman County, and winters are cool and moist. The period in which biological and chemical activity is operational depends on the length of time the soil is moist under favorable temperatures. Since most of the soils are dry or nearly dry during the warm months, they frequently are not moist when the favorable temperatures prevail. The moisture regime depends on the effectiveness and timing of precipitation ; also, it is influenced by soil characteristics. Temperature is a measure of heat that is available for chemical, physical, and biological reactions involved in soil formation. 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 content of organic matter, consequently, is lower.

Past climatic conditions

Past climatic conditions in the county, especially during the Pleistocene, alternately favored soil formation and soil truncation or burial. Soil profiles formed during periods when sedimentation or erosion proceeded slowly and soil forming processes were active for a significant length of time. Glacial intervals were periods of soil truncation or burial, and interglacial intervals of the Pleistocene were periods of soil formation. Paleosols are often truncated down to resistant caps of caliche or B horizons that are rich in clay. Relict soil features reflect former moisture regimes. Former periods of freezing climates resulted in frost sorting and solifluction. Solifluction occurs when the ground is frozen part of the year, forming interstitial ice and lenses of ice, so that on thawing soils settle with a resultant downslope displacement. Some soils such as those of the Alpowa series on the side slopes of major drainageways, have stone lines that may be related to periods of erosion and deposition during solifluctional movements. Intense frost action during periglacial climate was a significant factor in the formation of patterned ground in central Washington. Mounds (biscuits) formed where a previous soil

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mantle was less than 6 feet deep and conditions became favorable for formation of ice-wedge polygons. Mounds are in channeled scablands on outwash terraces and in areas where basalt is very shallow to deep.

Soils that formed under prairie vegetation generally have a dark, friable surface layer high in content of organic matter and are saturated with bases (more than 50 percent). Some soils that occur at high elevations on north- and northeast-facing side slopes, such as Tekoa gravelly silt loam, deep, have these characteristics but are now supporting coniferous forest. This indicates that perhaps some prairie areas in Whitman County have been invaded by coniferous forests.

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.

The kinds of plants and animals present largely determine the kinds and amount of organic matter added to the soil and how this matter is incorporated with the mineral part of the soil.

When the first settlers arrived in Whitman County, the vegetation was predominantly bunchgrasses mainly bluebunch wheatgrass and Idaho fescue. Open stands of conifers, mainly ponderosa pine, are in small areas along drainageways and in the northeastern part of the county. The understory in these areas is grass and shrubs. Coniferous forests, mainly Douglas-fir, are on some of the buttes.

Man has drastically altered soils, especially the upper layers, by plowing and farming grassland and by clearing wooded areas. The decrease in content of organic matter and the acceleration of erosion in most of the steeper cultivated soils are evidences of man's influence.

Time

Time, as a soil forming factor, begins as soon as rock is exposed on the surface or a fresh mantle of loess is laid down. As soil formation progresses, characteristic

layers called horizons are formed. Some of the soils have been in place long enough to have formed strongly expressed horizons; others are unaltered or only slightly altered parent material. The length of time required for a soil to develop depends on the nature of the parent material and the modifying effect of the other soil-forming factors.

Parent Material Origin and Age Relationship

The oldest geologic materials in Whitman County from which soils have formed are Precambrian metasediments of the Belt Supergroup. The metasediments consist of quartzite, schists, gneisses, and related rocks. These sediments were subjected to metamorphism, injections of pegmatite by granitic intrusions, and folding. Major exposures of granitic rock in Whitman County are Bald Butte and Granite Point. The metasediments were uplifted and dissected to form a mountainous terrain. During the early Tertiary period deep weathering of metasediments and exposed granodiorite occurred under a subtropical or tropical climate. Residual clay deposits more than 100 feet thick were formed in places. A remnant of this strongly oxidized profile is on Kamiak Butte.

During Miocene-Pliocene time, many extensive lava flows extruded through fissures. Whitman County was covered, except for some of the highest hills of metasedimentary rock. The lava flows caused disruption of drainages resulting in slackwater clay deposits, which are called the Latah Formation. The weight of the lava caused the Columbia Plateau basalt to tilt downward toward the Pasco Basin.

Basalt is exposed mainly on side slopes of major drainageways and in channeled scablands. Most loess basalt contacts are quite abrupt, suggesting that some erosion of previously weathered basalt took place prior to the deposition of the loess. In places residual soils have formed in weathered basalt. Some soils on valley and canyon sides in Whitman County have older B horizons that contain rounded basalt fragments and some soft weathered basalt fragments. Elsewhere, older B horizons contain basalt fragments with sharp edges that indicate less weathering. The oldest B ho-

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horizons probably have been destroyed by frost churning or solifluction.

The complex origin of the loess in terms of multiple processes has been postulated. Local ponding, streams, and sheet wash play a secondary role in loess deposition.

Studies that tied the Palouse loess to the Ringold Formation have been made. Most of the Ringold Formation is believed to postdate the broad folding and dissection of the Columbia Plateau in Pliocene time, though in the deeper parts of the basins it may contain some sediments contemporaneous with downwarping. This formation is considered to be the major source of loess deposits older than the channeled scablands, but other sources of loess have been involved for areas not downwind from any known deposits of Ringold. Undoubtedly some loess was blown southward from the Cordilleran Ice Sheet as a periglacial phenomenon. Some post-scabland loess was derived from the lacustrine Touchet Beds, and probably some was derived from alluvium along the Snake and Columbia Rivers.

Particle size of loess tends to decrease toward the more elevated parts of the Palouse Hills with increased distance from the source of loess. Some particles are

moved parallel to the ground surface at no greater height than a few yards, while the turbulent action of wind results in others being carried high above and horizontal to the ground for many miles. The gradual decrease in the carrying capacity of the wind with increasing distance from the source of loess would account for the particle size decrease. Since deposition, different rates of weathering caused by differences in precipitation have influenced particle size. This is reflected by the increase in clay fraction in the wetter environments.

The cumulative loess thickness exceeds 250 feet in the south-central part of Whitman County and is about 80 feet in the northeastern corner.

The approximate ages and some of the important properties of the various loess deposits in Whitman County are as follows:

Post-Pinedale.-Less than 6,700 years old. Horizon development is minimal.

Pinedale.-6,700 to 25,000 years old. Generally, profiles are 18 inches to 3 feet thick, have moderate structural grade, and have a slight increase of clay in the B horizon.

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All tables have been updated and are available as a separate document.

Bull Lake.-25,000 to 50,000 years old. Generally, profiles are 3 to 10 feet thick. Where annual precipitation is less than 18 inches, chalky white Cca horizons are present. Where annual precipitation is more than 18 inches, argillic horizons having strong structural grade are present.

Pre-Bull Lake.-More than 50,000 years old. Generally, profiles are more than 10 feet thick. Where annual precipitation is less than 18 inches, indurated siliceous caliche, hard manganese dioxide concretions, and pink Cca and Ccasim horizons are present. Remnants of platy caliche persist even where B horizons are missing. Where annual precipitation is more than 18 inches, strongly developed, highly oxidized (7.5YR and 10YR hues) argillic horizons containing hard manganese dioxide concretions are present.

The soils in Pre-Bull Lake and Bull Lake loess deposits have formed B horizons that have well expressed structure. These horizons formed during the early portion of interglacial periods when both adequate precipitation and relative warmth prevailed. Drier periods followed, and carbonates engulfed the pre-existing

B horizons or were deposited on top of them in the more arid regions. The loess deposits have extremes of salt and carbonate accumulation in the drier areas but low salt and carbonate content when followed eastward to progressively wetter areas. The B horizons in the drier areas contain little clay, and those in the eastward wetter areas are rich in clay. This indicates that the wettest areas during past climatic fluctuations are still the wettest and the driest areas are still the driest, even though the precipitation might have been greater or less in the past than it is now.

Concentrations of calcium carbonate (caliche) were formed during interglacial intervals of the dry phase. At those times leaching was minimized, and water and dissolved salts were drawn upward by capillary action. Thus, loss of much water by evaporation into the air occurred, and concentrations of calcium carbonate remained. The major calcium carbonate accumulations in Whitman County appear to result from a combination of precipitation, eolian sources, and pedogenic processes.

The floods of glacial meltwater that eroded the channeled scablands left a remarkable network of channels with erosional and depositional features un-

like those of normal stream valleys. Gravel and sand deposits are also on the foot slopes of the Snake River breaks in Whitman County. The upper limit of deposits from slack water off the Snake River is considered to be 1,200 feet above sea level.

Pinedale and Post-Pinedale loess deposits are draped over all earlier deposits. Middle Pinedale and Post-Pinedale loess deposits also occur on parts of the channeled scablands and thus locally are more extensive though thinner than earlier loess deposits. Mounds in the channeled scablands contain remnants of both of these loess deposits. The B horizons in Middle Pinedale loess are truncated by Post-Pinedale loess at the outer edges of the mounds.

Amphiboles (hornblende) are the dominant heavy minerals in the loess deposits in Whitman County. Epidote, opaques, hypersthene, pyroxenes, and other heavy minerals are present in lesser amounts. Quartz, feldspar, and mica are the dominant light minerals, and volcanic glass is present in varying amounts. Pinedale and Altiathermal and Post-Altiathermal loess deposits contain more volcanic glass than earlier loess, and some are more than 30 percent volcanic glass. The mineral composition indicates that these sediments are transported, because they contain significant amounts of quartz and potassium feldspar not found in the locally weathered basalt. Weathered basalt has considerable amounts of calcic plagioclase and pyroxene phenocrysts in the very fine sand fraction.

Along streams and in basins the main parent material is alluvium derived primarily from loess. Some sections may contain sandy lenses or ash layers, however, or may be a mixture of loess with metasedimentary material or basalt. Mount Mazama volcanic ash (6,700 years old) has been identified in two layers of Caldwell silt loam, drained-one at 59 to 69 inches and another at 69 to 80 inches. Hence, for this profile, alluvium above 59 inches is Post-Pinedale, and its accumulation postdates the development of large meandering Pinedale streams. Volcanic ash layers were found at only one site of Caldwell silt loam, drained. Such layers (probably layers of Mount Mazama volcanic ash) occur in many places in Covello and Hermiston soil profiles. Apparently most of the alluvium is Post-Pinedale, with clay-rich B horizons and some C horizons of Pinedale alluvium.

Topographic and Structural Control

The origin of the topography in Whitman County has been the subject of several studies. Some have suggested that the primary topographic features were produced by erosion and not by deposition, and that the hills resembled sand dunes with amphitheaterlike enclosures on the northern sides. Others have theorized that the dunelike shape of these hills was the result of late summer winds shifting dry soil from the southwest slopes to the lee side of the hills. Some have suggested that drainage patterns are not a normal dendritic pattern but that cirque-like amphitheaters result from accumulation of deep snowdrifts on the north and east slopes resulting in nivation and slumping. A combination of two processes has been sug-

gested: the accumulation of snow along with some soil on the upper part of the slopes and erosion at the toe of the snowdrifts. Sharpening of the steep north slopes occurred during Pinedale time, and present erosion is aggravated by slumping of the Post-Pinedale loess, which contains considerable amounts of volcanic ash and is underlain by a slowly permeable B horizon. The southwest and northeast alignment of topography in the western part of Whitman County undoubtedly was caused by strong prevailing winds from the southwest. Alignment of hills results from loess whose median grain size exceeds 0.0270-0.0280 mm. High wind velocity is required to carry these relatively coarse particles. The finer fraction of loess would be deposited only when winds reached a lower velocity. Low velocity winds are considerably more variable in direction, so the areas with finer fractions of loess do not possess the linear topography. Possibly the landforms were the products of both erosional and depositional processes, and erosion was dominant in the wetter eastern areas while deposition was dominant in the drier western areas where linear topography has been recognized. The wetter eastern part of Whitman County has asymmetrical hills and more complex landforms than the drier western part. The landforms in the eastern part are the products of a combination of erosional and depositional processes under the influence of vegetative differences. Thick loess deposits have accumulated on the leeward side of bedrock ridges. In general each deposit progressively overlaps previous surfaces, so that each deposit over a preexisting surface is thicker on northeasterly slopes, which results in a shift northeasterly in drainage divides. Loess also accumulated in hollows between snowdrifts during winter months.

Tillage erosion has accelerated the natural process of shaping the landscape. Both water erosion and tillage erosion are prevalent in Whitman County. They are affected by climate, the soil itself, and soil treatment or other management. Earth flows occurred above the B'2t soil horizon on northerly slopes and were a very important factor in the shaping of the hills.

Major streams such as the Palouse River have maintained their preloess drainageways. Loess deposits are draped down into some of the drainage channels. Modern first and second order drainageways are independent of bedrock configuration and are usually cut in loess only. High, steep hills in the St. John and Wilcox areas have resulted from greater stream entrenchment brought about by steeper stream gradients. These gradients were caused by inclination of the basalts and the thicker loess deposits. Areas with thin loess deposits on a rather smooth and flat basalt surface have hills of low relief.

In the eastern part of the county, three microclimates have been considered in previous studies in areas with convex narrow ridgecrests. The north- and northeast-facing side slopes were more moist where snow accumulated in drifts and melted slowly. The more exposed ridgecrests were the driest, and other areas were considered to be intermediate in amount of effective precipitation. Some soils are characterized by an excess of moisture because of profile characteristics that restrict water percolation or be-

cause the soil is in a low area. These differences in moisture are expressed in differences in degree of soil development and type of vegetation present.

Generally as elevation increases, precipitation increases and temperature decreases. Thus, there is more total plant growth and slower decomposition of organic materials at higher elevations in the eastern part of Whitman County than there is at lower elevations in the western part.

Soils with minimal profile development can be observed on steep side slopes of major drainageways and in places on buttes. In these areas, rate of soil development is equal to or exceeded by removal of surface soil by erosion or disturbance by mass movement. Solifluction was probably a potent agent in mass movement during former freezing periods. Even where steep soils have excellent vegetative cover, gravity can cause slow mass movement downslope, thus reducing the effects of soil formation.

Characteristics of Dominant Soils

The degree of horizon differentiation in dominant soils that formed mainly in Pinedale and Post-Pinedale loess deposits increases from the west to east. The soils in this sequence are in the Ritzville, Walla Walla, Athena, and Palouse series.

Organic matter

Thickness of mollic epipedons and content of organic matter increase with increased rainfall. The mollic epipedon of Ritzville soils ranges from 8 to 14 inches thick. The organic matter content of the dark brown A horizon is 1 to 1.3 percent. The mollic epipedon of Walla Walla soils ranges from 10 to 18 inches thick. The organic matter content of the very dark brown All horizon is 1.3 to 2.2 percent, and that of the very dark grayish brown A12 horizon is 1.0 to 1.7 percent. The mollic epipedon of Athena soils ranges from 20 to 30 inches thick. The organic matter content of the very dark brown Ap horizon is 1.6 to 3 percent, and that of the very dark brown A12 horizon and very dark grayish brown A13 horizon is 1.5 to 2.7 percent. The upper part of the B horizon with its dark brown colors and 1.0 to 1.5 percent organic matter still meets the requirements of a mollic epipedon. The mollic epipedon on the Palouse soils ranges from 20 to 36 inches thick. The organic matter content of the very dark brown Ap horizon is 2.6 to 4.2 percent. The organic matter content of the very dark brown Al horizon is 2 to 3.3 percent. The organic matter content of the very dark grayish brown A3 or dark brown B1 horizon is 1.0 to 2.7 percent.

Soil reaction and base saturation

Reaction tends to decrease as precipitation increases. Ritzville soils formed under 9 to 12 inches of annual precipitation and have the highest reaction; Palouse soils formed under 18 to 24 inches of annual precipitation have the lowest reaction. Decomposition of organic matter produces both organic and inorganic

acids. Thus, as precipitation increases there is more organic matter, vegetation, and downward movement of water, resulting in more intense and deeper leaching of soils. Reaction in Ritzville soils is neutral to mildly alkaline in the A horizon, neutral or mildly alkaline in the B horizon, and moderately alkaline or strongly alkaline in the C horizon. Reaction in Walla Walla soils is neutral in the A horizon, neutral or mildly alkaline in the B horizon, and mildly to strongly alkaline in the C horizon. Reaction in Athena soils is slightly acid to neutral in the A horizon, neutral to mildly alkaline in the B horizon, and mildly alkaline to strongly alkaline in the C horizon. Reaction in Palouse soils is medium acid to neutral in the A horizon and slightly acid to neutral in the B horizon. Palouse soils do not have a C horizon within a depth of 60 inches.

Precipitation can also affect base saturation. Higher precipitation is usually associated with greater leaching, which results in lower base saturation. Palouse soils, in a higher precipitation area, have the lowest base saturation percentage and the highest organic matter percentage. Ritzville soils have the highest base saturation—79 to 100 percent in the A horizons, 82 to 100 percent in the B horizons, and 85 to 100 percent in the C horizons. Base saturation of Walla Walla soils is 69 to 89 percent in the A horizon, 78 to 90 percent in the B horizons, and 93 to 100 percent in the C horizon. Base saturation of Athena soils is 68 to 92 percent in the A horizon, 77 to 85 percent in the B horizon, and 86 to 100 percent in the C horizon. Base saturation of Palouse soils is 65 to 71 percent in the A horizon, (up to 77 percent in the A3 horizon) and 68 to 87 percent in the B horizon. Presently the Palouse soils are considered to have an average base saturation of less than 75 percent in the upper 30 inches.

Calcium carbonate

The calcium carbonate (lime) layer is variable in the Ritzville, Walla Walla, Athena, and Palouse soils.

Ritzville soils are defined as having segregated lime in pores and root channels at depths of 30 to 43 inches. Many Ritzville pedons in this area have a highly calcareous, noncemented, relict calcium carbonate horizon below the segregated lime.

Walla Walla soils on most ridgetops have lime at a depth of 43 to 60 inches or more, but on other slopes in Whitman County lime is mostly below a depth of 60 inches. The lime layer in some Walla Walla soils is weakly cemented, has an abrupt boundary, and usually reflects a relict Cca horizon. In some Walla Walla soils, however, accumulation of lime occurs above the relict Cca horizon.

Athena soils on most ridgetops and southerly facing slopes have lime at a depth of 43 to more than 60 inches. The lime is at a depth below 60 inches in most Athena soils with west-, east-, and north-facing slopes. The depth to lime in these Athena soils is possibly the result of thicker loess deposits, more moisture, and deeper leaching. The abrupt boundary to the Cca horizon suggests the presence of a relict lime horizon. Generally Athena soils adjacent to the Athena-Palouse transitional zone either lack lime horizons or have weakly defined ones. In some areas of broad flat slopes

adjacent to major drainages, however, layers with large amounts of lime are present.

Palouse soils are free of lime accumulations. When comparing soils arranged in the order of increasing precipitation, there is an increase in the degree of leaching of lime, but the depth of the relict Cca horizons appears to be related more to the thickness of Pinedale and Post-Pinedale loess depositions than to the degree of leaching.

Development of B Horizons

With increasing soil formation and horizon expression, B horizons usually exhibit a more oxidized (redder) color, have a higher percentage of clay, have stronger grades of structure, and are thicker. The B horizons in Ritzville soils have a value of 3 or 4 moist and 4 or 5 dry and a chroma of 3 or 4 either moist or dry. Ritzville soils are silt loams that are 6 to 12 percent clay. They have weak, coarse or medium, prismatic structure, and they extend to a depth of 20 to 38 inches.

The B horizons in Walla Walla soils have a value of 3 or 4 moist and 5 or 6 dry. Chroma is 3 moist or dry. Walla Walla soils are silt loams that are 11 to 18 percent clay. They have weak, medium or coarse, prismatic structure, and they extend to a depth of 31 to 52 inches.

The B horizons in Athena soils have a value of 3 or 4 moist and 5 or 6 dry. Chroma is 3 or 4 moist or dry. Walla Walla soils are silt loams that are 18 to 25 percent clay. They have weak or moderate, medium or coarse, prismatic structure, and they extend to a depth of 43 to 59 inches.

The B horizons in Athena soils have organic coatings on ped faces in the upper part, and some have incipient bleaching expressed as gray siliceous coatings on ped faces in the intermediate part.

The B horizons in Palouse soils have a value of 3 or 4 moist and 5 or 6 dry. Chroma is 3 or 4 moist or dry. Palouse soils are silt loams or light silty clay loams that are 20 to 30 percent clay. They have weak or moderate, medium or coarse, prismatic structure, and they extend to a depth greater than 60 inches. The B horizons have a few thin clay films and organic coatings on ped faces. Some have incipient bleaching expressed as gray siliceous coatings on ped faces. These siliceous coatings become more apparent on north exposures and in the northeastern part of Whitman County.

Relationship of Modern and Relict Landscapes to Present Distribution of Soils

Most soils in Whitman County have superimposed profiles, the result of the development of young weathering profiles on older and deeper ones. Superimposed profiles of different ages may be suggested by such discontinuities in the soil profile as abrupt change in texture, color, alkalinity, or acidity; or, in alkaline areas, by repetition of lime-free layers beneath lime-enriched layers. But the compelling evidence that a soil consists of two or more weathering profiles must be sought by tracing the weathered layers laterally to a place where the older layers become separated from the base of the

younger ones. Field identification of weathering profiles can be made by comparisons of profile thickness, depth of clay enrichment, and amount of oxidation under similar conditions.

The topography in Whitman County contains many facies of different ages. These have been exposed to soil forming processes under markedly different climatic conditions and for different lengths of time. Ritzville, Walla Walla, Athena, and Palouse soils have B horizons that formed in Pinedale loess. These soils have A horizons that formed in Post-Pinedale loess, but in places they have older loess in the lower part of the profile. In places the B3 horizons of Palouse soils appear to have formed in Bull Lake loess. In some areas these soils are interspersed with soils that have more advanced morphological soil characteristics, primarily because of their function on soil landscapes of greater age.

The drier, western part of Whitman County has linear hills. Walla Walla soils are dominant in this part of the county. Small areas of Ritzville soils are in the southwestern part of this area. Areas of Walla Walla soils are interspersed with small areas of Endicott and Risbeck soils.

Endicott and Risbeck soils are in parts of the landscape where Pinedale and Post-Pinedale loesses are thinner. Endicott soils have 20 to 40 inches of Pinedale and Post-Pinedale loess deposits over Pre-Bull Lake and Bull Lake loess deposits that contain a lime-silica cemented hardpan. Pre-Bull Lake loess deposits characteristically have more strongly cemented lime horizons than Bull Lake loess. Consequently, variability in lime cementation depends on which loess unit is present. Endicott soils are on ridgetops and low-lying broad benches. It appears that on the low-lying broad benches along edges of channeled scablands, floodwaters may have stripped away part of the Pre-Bull Lake and Bull Lake loess deposits down to the resistant lime-silica cemented hardpans. Risbeck soils are on the side slopes and ridges where calcareous Pre-Bull Lake and Bull Lake loesses are exposed. They formed in calcareous loess consisting of alternating layers of lime hardpan and loose limey silt of variable thickness and in colluvium from this material intermixed with some Pinedale and Post-Pinedale loess.

The wetter, eastern part of Whitman County has asymmetrical hills. Athena soils are dominant in the western and southern parts of this area. They are interspersed with small areas of Lance and Calouse soils. Palouse soils are dominant in the eastern part. They are interspersed with Thatuna, Naff, Garfield, Staley, and Tilma soils.

Lance and Calouse soils are in parts of the landscape where Pinedale and Post-Pinedale loess deposits are thin. Lance soils are on side slopes and ridgetops where calcareous Pre-Bull Lake and Bull Lake loess deposits are exposed. They formed in calcareous loess consisting of alternating layers of cemented caliche and loose limey silts of variable thickness and in colluvium of this material intermixed with some Pinedale and Post-Pinedale loesses. Calouse soils have 20 to 40 inches of Pinedale and Post-Pinedale loess deposits over Pre-Bull Lake and Bull Lake noncemented calcareous loess deposits. The characteristics of Cca horizons depend on which of the earlier loess deposits

is present and on the influence of recent environmental conditions. The Calouse soils are on the side slopes and ridgetops.

Naff and Garfield soils formed on low-lying old surfaces of the landscapes that have been reexposed for soil forming processes to again be activated. Naff and Garfield soils have strongly oxidized and clayey B horizons. It appears that their B horizons formed during the Pleistocene epoch when the geomorphic surface was stable for a long period. The B horizons of these soils are considered to be largely relict, but silicate clay presently is accumulating in the upper parts. In some pedons buried portions of the B horizons have degraded. For example, the Naff and Garfield soils formed in more than one Pre-Bull Lake unit. Thus, variation in expression of the B horizons depends on which loess deposit it formed in and the amount of available moisture induced under differing topographic positions. The argillic B horizons of Naff and Garfield soils have oriented clay skins and develop vertical cracks about one-fourth to one-half inch wide down to a depth of 20 to 30 inches when dry. Naff soils have an A horizon of Post-Pinedale loess and in places have an AB or B1 horizon of Pinedale or Bull Lake loess. But Garfield soils normally occur on ridgetops and knobs where Post-Pinedale and Pinedale loess failed to accumulate and the A horizon developed mainly in Pre-Bull Lake loess.

It appears that Tilma and Naff soils have the same relict B horizon. In places Tilma soils form on the lower edges of Naff soils where there is increased available moisture and some thickening of the Post-Pinedale loess. Thus, Tilma soils occur where there is more available moisture and have A2 horizons and more strongly expressed argillic B horizons than Naff.

The argillic B horizons of Thatuna soils formed in more than one loess deposit. Thus, variation in expression of the horizons depends on which loess deposit they have formed in and the amount of available moisture induced under differing topographic positions. Thatuna soils formed in Pre-Bull Lake and Bull Lake loess deposits, and their B horizons contain no ash. This indicates that their argillic B horizons formed in loess older than that of Pinedale age. The argillic B horizons of Thatuna soils are not as strongly oxidized as the argillic B horizons of Naff and Tilma soils, and they probably formed more recently than those in Naff and Tilma soils. The argillic horizons of Thatuna soils are considered to be largely relict, but silicate clay presently is accumulating in the upper parts of the horizon.

The location of the A'2 horizon in Thatuna soils was established by abrupt changes in compaction and permeability occurring at the lower boundary of loess modified by volcanic ash.

In areas near the towns of Steptoe, Colfax, and Pullman, Thatuna soils are on concave and smooth north and northwest slopes and on foot slopes. Thatuna soils appear to occur mainly in parts of the landscape that were sharpened during Pinedale time. In most places they are between convex areas of Palouse soils. Palouse soils on these convex slopes have some bleaching on ped faces in the upper part of B horizons. Thatuna soils in these areas have A3 horizons instead of B2 horizons over A'2 horizons. The weakly formed Post-Pinedale

B horizon appears as the present A3 horizon of Thatuna soils.

In northeastern Whitman County Thatuna soils have B2 horizons above the A'2 horizon. Stratigraphically it appears that Thatuna soils with an A1, A3, A'2, and B'2t horizon sequence are in parts of the landscape that have been subjected to nivation and slumping and the resulting removal of B2 horizons. These B2 horizons are probably Pinedale loess, and the A1 horizons are Post-Pinedale loess. The A'2 horizon for Thatuna soils with A1, B2, A'2, and B2t horizon sequence may be a degraded A1 horizon. The degradation of former A1 horizons to horizons similar to A'2 horizons has been observed in several road cuts in Whitman County.

Thatuna soils have a thicker than normal dark A horizon. During the Post-Pinedale period (xerothermic maximum), vegetation was thinner and shorter particularly on west- and south-facing slopes. Strong prevailing winds from the southwest redeposited the volcanic veneer from slopes with sparse vegetation to the north and northeast slopes on the other side of the ridge. Redeposition of loess would be unlikely even during dry periods when vegetation was sparse because undisturbed surfaces would be protected by cryptogams. During part of the Post-Pinedale period probably not much loess material was deposited other than volcanic ash. Also in the Athena-Palouse transitional area, thick nearly pure ash layers have been found on the north slopes. These ash layers are also in the Walla Walla area on the north and northeast slopes, which indicates that during this period little loess was deposited with volcanic ash. Probably there has been a differential vegetative cover in this area during loess deposition which still persists today. The taller and more luxuriant vegetation is confined to the leeward slopes and to higher areas to the east where precipitation is more effective. The luxuriant vegetation traps and holds the volcanic-influenced material in those localities. Gradual accumulation of volcanic-influenced material may explain the thick A horizon of the Thatuna soils.

Fringe areas and areas more distant from the source of loess have thinner individual deposits of each age of loess; thus, older loess deposits are near the surface. Whitman County is in the more central part of the loess deposits and has thick loess layers. In some small areas loess layers are thinner, however, or some of the loess deposits are absent. These areas are on ridgetops, southerly side slopes, shoulders, and knobs. In other areas thinner layers of loess are on large portions of the landscape.

Reardan soils are mainly on low-lying broad benches along the edges of the channeled scablands. It is postulated that flood water stripped away the soil material above the resistant B horizons. Gravel has been observed on top of the B horizon and between peds of the upper part of the B2t horizon of Reardan soils. Reardan soils have an A1, B&A sequence over the B2t horizon.

Classification of the Soils

The system of soil classification used was adopted by the National Cooperative Soil Survey in 1965.

Readers interested in further details about the system should refer to the latest literature available (7).

The system of L' classification has six categories. Beginning with the broadest, these categories are order, suborder, greatgroup, subgroup, family, and series. In this system the bases for classification are the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In

table 14 the soils of the survey area are classified according to the system. Categories of the system are briefly discussed in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in sol. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and that are important to plant growth or that

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All tables have been updated and are available as a separate document.

were selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning moist in winter and dry in summer, plus *oll*, from Mollisol.)

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. The name of a great group ends with the name of a suborder. A prefix added to the name suggests something about the properties of the soil. An example is Haploxerolls (*Hapl*, meaning simple horizons, plus *xeroll*, the suborder of Mollisols).

SUBGROUP. Each great group is divided into three kinds of subgroup: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extra-grades that have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. The names of subgroups are derived by placing one or more adjectives before the name of the great group. The adjective *Typic* is used for the subgroup that is thought to typify the great group. An example is Typic Haploxerolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is coarse-silty, mixed, mesic, Typic Haploxerolls.

SERIES. The series consists of a group of soils that are formed from a particular kind of parent material and have horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Climate

The climate of Whitman County is influenced to a great extent by the prevailing westerly winds and the Cascade and Rocky Mountain ranges. The Rocky Mountains shield this section of Washington from the more severe winter storms that move southward across Canada, while the Cascade range forms a barrier to the easterly movement of moist air from the Pacific ocean. However, some of the air from each of these source regions reaches the Inland Basin and produces a climate similar to the continental and marine types.

Most of the air masses and weather systems crossing

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the survey area are under the influence of the prevailing westerly winds. Infrequently, dry continental air masses enter this region from the north or east. During summer, this air from the continent results in low humidity and high temperatures, while in winter the weather is clear, cold, and dry. Extreme temperatures in both summer and winter generally occur when the Inland Basin is under the influence of air from the interior of the continent. Occasional outbreaks of cold, continental air in spring and fall have caused extensive crop damage. Precipitation data for Whitman County are presented in tables 15 through 18; temperature data is presented in these same tables and also in tables 19 and 20, table 20 providing probabilities of freezing temperatures in spring and in fall.

Summers are warm, dry, and sunny in Whitman County. Afternoon temperatures in the warmest summer months range from 80 to 90 F and occasionally reach the upper nineties or 100. Temperatures drop rapidly after sunset, and nighttime readings range from 45° to 55°. Maximum temperatures have reached 90 or higher on 40 days in the warmest summers and on less than 10 days during the coolest. The highest temperature recorded in the survey area is 113. The average diurnal range in temperature is about 30 in summer, 10 in winter, and 15 to 20 in spring and fall.

Through the warmest months, relative humidity ranges from approximately 60 percent at sunrise to 25 percent in midafternoon. In spring and fall, the range is from 75 percent at sunrise to 5 percent in the afternoon; in winter it is from 90 percent at night to 80 percent during the day.

In winter, weather systems moving eastward across Washington and an occasional system moving southward from Canada result in frequent weather changes. On a typical winter day, the afternoon temperature is near freezing and the nighttime reading is in the lower twenties. During an average winter, maximum temperatures fail to rise above freezing on about 1 day in 3 and minimum temperatures drop to zero or lower on 3 to 6 nights. In January, generally the coldest month, minimum temperatures can be expected to drop to 0 or lower on 1 or more nights in 1 out of 2 years, -10° in 1 out of 3 years, and -20° F in 1 out of 5 years.

Precipitation is light during summer. It increases in fall, reaches a peak in winter, then decreases in spring, with a slight increase in June and a sharp decline about the first of July. In an average year, thunderstorms occur on 8 to 15 days between March and October. Thunderstorms in midsummer are generally limited to isolated cells rather than a line of storms covering a wide area. As a result, crop damage from heavy precipitation or hail is generally confined to comparatively small areas. One summer in 10 has a total rainfall for July and August of less than 0.01 inch. Likewise, 1 year in 10 has rainfall during these months of more than 1 inch. During each month in fall, the total rainfall can be expected to range from approximately 1/2 inch to 4 inches in 8 years out of 10.

Most of the winter precipitation between mid-December and mid-February is snow. The average annual snowfall ranges from 25 inches in the western part of the survey area to 35 inches in the eastern part.

or rain on a snow cover sometimes results in rapid melting, heavy runoff, severe erosion, and flooding along the larger streams.

Generally, precipitation increases in an easterly direction across the survey area. Average annual precipitation ranges from approximately 11 inches in the lower elevations near the western edge of the survey area to 23 inches in the higher elevations near the Idaho border. One year in 10 generally has an annual precipitation of less than 10 inches at the western edge of the survey area. Also, this same area will probably receive more than 20 inches of annual precipitation in 1 out of 10 years. In the eastern part of the survey area, heavier annual precipitation in the past has ranged from 15 to 28 inches in 8 out of 10 years.

Depth of frost in the soil varies from year to year and is influenced by the snow cover and temperature. Frost in the ground reaches a depth of 10 to 20 inches in a typical winter. In extremely cold winters when there is light snow cover, depth to frost ranges from 25 to 30 inches or more. During winter, moist air that crosses the Cascade Mountains and mixes with the colder air in the Inland Basin results in considerable cloudiness and some fog. Frost collects on highways, trees, utility wires, and other objects. Moderate to heavy fog forms on an average of 3 to 10 nights each month from the end of November through February.

The number of clear or only partly cloudy days each month increases from less than 10 in midwinter to 25 or more in midsummer. Sunshine data recorded at Spokane is fairly representative of this area. Possible

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All tables have been updated and are available as a separate document.

Annual snowfall ranges from less than 5 to more than 50 inches. A snow cover generally remains on the ground more than half the time between the middle of December and the end of February. Snow reaches a depth of 6 to 10 inches almost every winter, and depths ranging from 20 to 28 inches have been recorded during the seasons of heaviest snowfall. A Chinook wind

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sunshine during each month ranges from 20 to 30 percent in winter, 50 to 60 percent in spring and fall, and 80 percent or more in summer. The number of hours of possible sunshine on a clear day ranges from 8 in December to 16 in June.

During summer, the prevailing direction of the wind is from the southwest and the average velocity ranges from 7 to 8 miles per hour. Velocities more than 20 miles per hour seldom occur. During fall and winter, the frequency of winds from a northeasterly direction increases. In some winter months, the number of days with winds from an easterly quadrant exceeds the number from a westerly quadrant. The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities at an elevation of 30 feet can be expected to reach 50 miles per hour at least once in 2 years, 65 to 75 miles per hour once in 50 years, and 80 miles per hour once in 100 years.

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Glossary

- Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.
- Area reclaim.** An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.
- Ash, volcanic.** Consists of small particles of solid or porous fragments of obsidian or pumice, which look like coarse ashes, ejected in volcanic activity.
- 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 60inch profile or to a limiting layer is expressed as
- | | Inches |
|-----------------------|---------------|
| Low ----- | 0 to 3.75 |
| Moderate ----- | 3.75 to 5.0 |
| Moderately high ----- | 5.0 to 7.5 |
| High ----- | More than 7.5 |
- Base saturation.** The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.
- Bottom land.** The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

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.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are

Loose.-Noncoherent when dry or moist; does not hold together in a mass.

Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.-When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.-When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.-When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.-When dry, breaks into powder or individual grains under very slight pressure.

Cemented.-Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or closegrowing crops are alternated with strips of clean-tilled crops or summer fallow.

Contour tillage. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Crop rotation. The growing of different crops in recurring succession on the same field.

Cross-slope farming. Plowing, cultivating, planting, and harvesting across the general slope, but not on the contour as in contour farming.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Dendritic drainage. A drainage pattern in which the streams branch irregularly in many directions and at almost any angle, resembling in plan the branching of certain trees, as oaks or maples.

Depth, soil. Five general depth classes of soil to bedrock, hardpan, sand and gravel, or other layer are recognized; (1) Very shallow-5 to 10 inches deep; (2) Shallow-10 to 20 inches deep; (3) Moderately deep-20 to 40 inches deep; (4) Deep-40 to 60 inches deep; and (5) Very deep-more than 60 inches deep.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Divided slopes. Protecting slopes where stripcropping is impractical by dividing them once. A strip of grain and a strip of peas, lentils, spring grain, or fallow are alternated yearly, or legumes and grass are grown on one of the strips.

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 for 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, as for example in "hillpeats" and "climatic moors."

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Erosion hazard. Susceptibility to water erosion or soil blowing. The terms used in this survey are slight, moderate, high, and very high. These terms are relative and apply only in relation to other soils of Whitman County.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November-May for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

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.

Herbage. Sum total of all annual growth of grasses and forbs.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon. An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.-The mineral horizon, formed or forming 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.

A₂ horizon.-A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay; sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Low strength. Inadequate strength for supporting loads.

Metasediments. Sediment or sedimentary rock that shows evidence of having been subjected to metamorphosis.

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).

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. The term glacial outwash as used in this publication also includes glacial flood deposits from Lake Missoula. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Paleosol. A buried soil, especially one formed during an interglacial period and covered by deposits or a formerly buried soil that has been exposed by the stripping of the overlying deposits by later advances of the ice.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0

inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as

| pH | | pH |
|--------------------|-----------------|---|
| Extremely acid | ___ Below 4.5 | Neutral ----- 6.6 to 7.3 |
| Very strongly acid | 4.5 to 5.0 | Mildly alkaline ---- 7.4 to 7.8 |
| Strongly acid | ---- 5.1 to 5.5 | Moderately alkaline _7.9 to 8.4 |
| Medium acid | ---- 5.6 to 6.0 | Strongly alkaline ___8.5 to 9.0 |
| Slightly acid | ---- 6.1 to 6.5 | Very strongly alkaline ----- 9.1 and higher |

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

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.

Scabland. Land, mainly flat and basalt-covered, that has a thin soil cover, sparse vegetation, and deep, dry channels (channeled scabland) scoured into the surface.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

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.

Slick spot. Locally, a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solifluction. The slow downslope flow, or creep, of waterlogged soil or other loose material. Results in the formation of small terraces common in arctic and mountain regions.

Solum. The solum part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are platy (laminated), 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).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface soil. The soil ordinarily removed 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."

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil.

An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.