

SOIL SURVEY OF
Glacier County Area and Part of Pondera County
Montana



**United States Department of Agriculture
Soil Conservation Service and
United States Department of the Interior
Bureau of Indian Affairs
In cooperation with
Montana Agricultural Experiment Station**

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1967-68. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service, the Bureau of Indian Affairs, and the Montana Agricultural Experiment Station. It is part of the technical assistance furnished to the Glacier County and the Pondera County Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of the survey area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the woodland suitability group, windbreak suitability group, and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by

using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites and the windbreaks suitability groups.

Foresters and others can refer to the section "Woodland," where the soils of the area are grouped according to their suitability for trees.

Ranchers and others can find under "Range" groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers, community planners, builders, and others can find under "Engineering Uses of the Soils" tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers to the area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the area given at the beginning of the publication and in the section "Climate."

Cover: A woodland-range transition zone. Adel soils in the foreground. Loberg soils and Chief Mountain in the background.

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SOIL SURVEY OF GLACIER COUNTY AREA AND PART OF PONDERA COUNTY, MONTANA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, and UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF INDIAN AFFAIRS, in Cooperation with MONTANA AGRICULTURAL EXPERIMENT STATION

GLACIER COUNTY AREA AND PART OF PONDERA COUNTY is in the northwestern part of Montana, east of the Continental Divide (fig. 1). It has a land area of 1,709,408 acres, or about 2,671 square miles. It includes all of Glacier County, except Glacier National Park and the Lewis and Clark National Forest lands, and it includes all of the Blackfeet Indian Reservation.

Cut Bank and Browning are the major towns in the survey area; Cut Bank is in the east-central part and Browning is in the west-central part. Major transportation is provided by U.S. Highways 2 and 89 and by railroad. Blackfeet Tribe offices and local offices of the Bureau of Indian Affairs are located in the survey area.

The topography of the survey area is varied. The eastern part is a complex of rolling, hilly, and nearly level plains. The southern part is plains intercepted by the steep valley walls of Cut Bank, Birch, and Two Medicine Creeks, all of which have their headwaters on the high mountain slopes that form the western boundary of the survey area. Westward from the plains along the Canadian border, the topography is broken by high plateaus dissected by the headwater streams of

the Milk River. The elevation of the eastern plains ranges from about 3,600 to 4,400 feet, of the western foothills from 4,400 feet to about 5,500 feet, and of the mountain foot slopes from 5,500 feet to more than 8,000 feet.

About 70 percent of the survey area is in native range, 21 percent is in dryfarmed crops, 2 percent is in irrigated crops, and 7 percent is in trees. The main dryfarmed crops are wheat and barley. Hay, pasture, wheat, and barley are the main irrigated crops. Most of the cropland is in the eastern two-thirds of the survey area. Petroleum has been an important industry in the economy of the area since the 1920's, and new petroleum developments seem to indicate that it will continue to be a source of income.

The dryfarmed acreage in the survey area has rapidly increased in the past 20 years. This increase has come mainly from conversion of native range on soils suited to crops. The newly cropped areas are well suited to wheat and barley, which have a relatively short growing season. Generally, areas of shallow soils, steep slopes, and key waterways have been left in native range, thus avoiding some common erosion hazards. Many areas of soils suited to crops are still in range.

The management of irrigated cropland in the area generally has been at a relatively low level. Recently greater emphasis has been placed on proper management of the soil, and the results have encouraged further development of the irrigation potential.

The soils in woodland are well suited to woodland. Timber production is slow, mainly because of low soil and air temperatures and the short summer season. The areas of woodland are, however, very valuable as watershed, for recreation and esthetic values, and as wildlife habitat.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the area, where they are located, and how they can be used. The soil scientists went into the area knowing they likely would find many soils they had already seen and perhaps some they had not. They

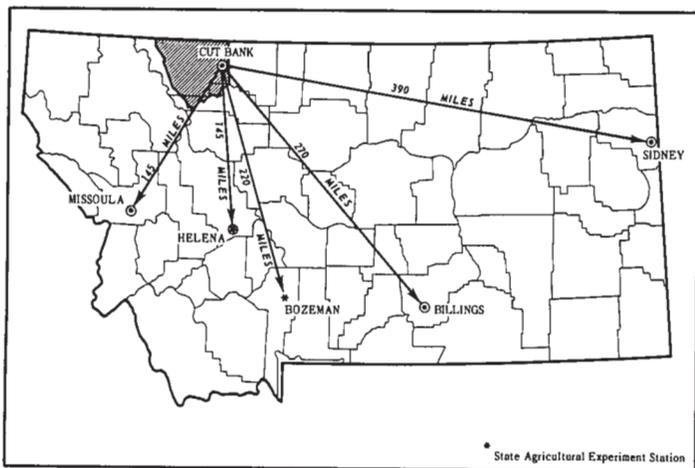


Figure 1.—Location of Glacier County Area and Part of Pondera County in Montana.

observed the steepness, length, and shape of slopes, the size and velocity 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 counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Ethridge and Babb, for example, are the names of two soil series. All the soils in the United States that have 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. 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, Kiev gravelly loam, 2 to 4 percent slopes, is one of several phases within the Kiev 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 to draw boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. 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 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. Three such kinds of mapping unit are shown on the soil map of the survey area: soil complexes, soil associations, and undifferentiated groups.

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. Hanson-Fifer complex, rolling, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils. The soils may differ greatly one from another or they may be very similar. The name of an association consists of the names of the dominant soils, joined by a hyphen. Loberg-Mord association, hilly, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils or of two or more. If there are two or more dominant soils the name of the group generally consists of the names of the dominant soils, joined by "and." Korchea and Kiwanis soils is an example.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock outcrop is an example.

While a soil survey is in progress, soil 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, foundation, 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, together 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, in color, the soil associations in the survey area. 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 to have 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.

The soil associations in this survey area have been placed into three broad groups for interpretive purposes. Each of the broad groups and the soil associations in each group are described in the following pages.

Dominantly Deep, Well-Drained and Somewhat Excessively Drained, Undulating to Very Steep Soils on Mountains and Adjacent Uplands

Five soil associations are in this group. The soils in these associations developed mainly in glacial till, colluvium, and old alluvium weathered from sandstone, shale, limestone, argillite, and quartzite. The mean annual precipitation is 15 to 35 inches, elevation ranges from 4,300 to 6,500 feet, and the growing season is 60 to 90 days. Areas of these soils are used mainly for woodland or range. The native vegetation is mainly lodgepole pine, spruce, aspen, limber pine, and tall and mid grasses.

1. Loberg-Whitore association

Deep, dominantly rolling to very steep, well-drained and somewhat excessively drained stony loams formed in material derived from glacial till; on mountains

This association is between East Glacier Park and the Canadian border. The topography consists of glacial moraines, dissected glacial outwash terraces, and foot slopes of mountains. Parent material is weathered mainly from limestone, quartzite, and shale. Slopes are complex and range from 4 to 60 percent. The elevation ranges from 5,000 to 6,500 feet, and the mean annual precipitation is 20 to 35 inches.

This association occupies about 3.5 percent, or about 59,800 acres, of the survey area. It is about 60 percent Loberg soils and 15 percent Whitore soils. The rest is Mikesell, Sherburne, and Mord soils.

Loberg soils are in all positions on the landscape,

except on droughty, south-facing side slopes and on windswept ridgetops. These soils are well drained. They typically have 4 inches of organic material on the surface. The mineral surface layer is light gray stony loam 6 inches thick. The subsoil is brown, yellowish-brown, and grayish-brown cobbly clay loam 47 inches thick. The substratum is light-gray very cobbly clay loam.

Whitore soils are mainly on the droughty, south-facing side slopes and the windswept ridgetops. These soils are somewhat excessively drained. They typically have 2 inches of forest litter on the surface. The mineral surface layer is dark-gray cobbly loam 2 inches thick. The subsoil is brown cobbly clay loam 5 inches thick. The substratum, to a depth of 60 inches, is light-gray and light olive-gray, calcareous cobbly loam and cobbly clay loam that are 35 to 45 percent cobbles, pebbles, and stones.

Mikesell soils are near areas of shale bedrock. Sherburne soils are on remnants of old glacial terraces. Mord soils developed in glacial till and are mainly in grass parks and aspen groves.

Most areas of this association are used as woodland. Many timber stands are overmature, some are harvested, and some have been burned. Some areas are used as grazeable woodland, but the production of usable forage is limited by crown density. This association has high esthetic value. Because of winter snowpack, this association is important as watershed.

2. Sherburne-Loberg-Tenex association

Deep, moderately sloping to steep, well-drained gravelly, cobbly, and stony loams formed in material derived from glacial till, colluvium, and alluvium; on mountains and adjacent uplands

This association is north of Divide Mountain. The topography consists of moderately sloping glacial terraces and the surrounding moderately sloping to steep dissected slopes. The parent material weathered mainly from argillite, quartzite, and limestone. Slopes are simple to complex. They range from 4 to 35 percent. Elevation ranges from 4,800 to 6,500 feet, and the mean annual precipitation is 20 to 35 inches.

This association occupies about 1 percent of the survey area, or about 17,100 acres. It is about 30 percent Sherburne soils, 30 percent Loberg soils, and 20 percent Tenex soils. The remaining 20 percent is Mikesell, Mord, and Swifton soils.

Sherburne soils are mainly moderately sloping and are on terraces. These soils typically have 1 inch of forest litter on the surface. The mineral surface layer is light-gray gravelly loam about 1½ inches thick that contains a few stones. The upper part of the subsoil is light yellowish-brown and very pale brown gravelly loam about 16 inches thick, the middle 28 inches is light yellowish-brown gravelly clay loam, and the lower part is reddish yellow very cobbly clay to a depth of 90 inches.

Loberg soils are moderately sloping to steep and are on the dissected edges of the terraces. These soils typically have 4 inches of forest litter on the surface. The mineral surface layer is light-gray stony loam 6 inches

thick. The subsoil is brown, yellowish-brown, and grayish-brown cobbly clay loam 47 inches thick. The substratum is light gray very cobbly clay loam.

Tenex soils are moderately sloping and hilly and are on the dissected edges of the terraces. These soils typically have 1½ inches of forest litter on the surface. The mineral surface layer is light-gray sandy loam about one-half inch thick. The upper part of the subsoil is pale-brown cobbly loam about 4 inches thick, the middle part is light yellowish-brown cobbly light clay loam 19 inches thick, and the lower part is light yellowish-brown very gravelly sandy loam about 28 inches thick.

Mikesell, Mord, and Swifton soils are on the dissected terrace edges. Mikesell soils are near areas of shale bedrock. Mord soils are mainly in grass parks and aspen groves. Swifton soils are on foot slopes.

Most areas of this association are used as woodland and grazeable woodland. This association is the main timber harvest area, partly because of the moderate slopes and easy access. In areas of grazeable woodland, usable forage production is limited by high crown density. This association has high esthetic value. It also is valuable watershed because of the high snow-pack.

3. *Loberg-Mord-Rock outcrop association*

Deep, hilly to very steep, well-drained stony loams formed in material derived from glacial till and colluvium; on mountains

This association is south of East Glacier Park. The topography consists of high rocky ridges, steep and very steep mountain foot slopes, and hilly and steep glacial moraines. The parent material weathered mainly from sandstone, limestone, and shale. Slopes are simple and complex and range from 8 to 60 percent. Elevation ranges from 5,000 to 6,500 feet, and the mean annual precipitation is 20 to 30 inches.

This association occupies about 1.5 percent of the survey area, or about 25,600 acres. It is about 30 percent Loberg soils, 30 percent Mord soils, and 20 percent Rock outcrop. The remaining 20 percent is Adel, Swifton, and Whitore soils.

Loberg soils are moderately steep to very steep and are mainly on south-facing hillsides and foot slopes. These soils typically have 4 inches of organic material on the surface. The mineral surface layer is light-gray stony loam 6 inches thick. The subsoil is brown cobbly clay loam about 47 inches thick. The substratum is light-gray very cobbly clay loam that is calcareous below a depth of 40 inches in many places.

Mord soils are moderately sloping to steep and are mainly on south- and east-facing hillsides and foot slopes. Typically, the upper part of the surface layer is dark-gray stony loam 7 inches thick, and the lower part is grayish-brown loam 9 inches thick. The subsoil, to a depth of 60 inches, is brown silty clay with some cobbles and pebbles.

Rock outcrop is steep and very steep in fairly large areas on hillsides, ridgetops, and talus slopes, and is in small areas among Loberg and Mord soils. The talus slopes are mainly sandstone and limestone. The bedrock is mainly sandstone, limestone, and shale.

Adel soils are on foot slopes and the lee side of rock

ridges. Swifton soils are in areas similar to those of the Loberg soils. Whitore soils are somewhat droughty and are mainly near areas of limestone bedrock.

Areas of this association are used as woodland, grazeable woodland, and range. About one-third of the area has stands of commercial timber. Several areas are old burned-out forests that have only a few scattered trees or stands of young trees. The areas of Mord soils in this association are mainly rough fescue range, but a few areas have an overstory of aspen. This association has high esthetic value and is also valuable watershed.

4. *Adel-Babb-Hanson association*

Deep, undulating to steep, well-drained loams, cobbly loams, and stony loams formed in material derived from glacial till, colluvium, and alluvium; on uplands adjacent to the mountains

This association is north of East Glacier Park. The topography consists mainly of glacial moraines and dissected glacial outwash terraces. The parent material weathered mainly from argillite, quartzite, and limestone. Slopes are simple to complex. They range from 2 to 35 percent. Elevation ranges from 4,500 to 6,000 feet, and the mean annual precipitation is 15 to 24 inches.

This association occupies about 3 percent of the area, 51,200 acres. It is about 40 percent Adel soils, 40 percent Babb soils, and 10 percent Hanson soils. The remaining 10 percent is Mord and Nettleton soils.

Adel soils are mainly in concave areas. Typically, the surface layer is very dark gray loam 26 inches thick. The subsoil is dark grayish-brown loam 14 inches thick. The substratum is grayish-brown light clay loam.

Babb soils are mainly on the sides of hills and ridges and on tops of rounded knolls. Typically, the surface layer is black cobbly loam 7 inches thick. The subsoil is dark grayish-brown gravelly loam 14 inches thick. The substratum is white, calcareous gravelly or cobbly loam.

Hanson soils are on the tops of ridges and knolls and on south-facing side slopes. Typically, the surface layer is dark grayish-brown stony loam 12 inches thick. The underlying material is light gray and white, calcareous very stony loam.

Mord soils are on foot slopes; they have a subsoil of silty clay. Nettleton soils are near areas of shale; they have a surface layer of clay loam. Many small, poorly drained closed basins, intermittent lakes, and shallow lakes are also within areas of this association.

Most areas of this association are used for range. Rough fescue is the dominant grass. There is an overstory of aspen and an understory of grass, forbs, and shrubs in 30 to 50 percent of the area. Other important uses of this association are wildlife habitat, recreation, and watershed.

5. *Raynesford-Whitore-Hanson association*

Deep, undulating to steep, well-drained and somewhat excessively drained gravelly, cobbly, and stony loams formed in material derived from glacial till, colluvium, and alluvium; on uplands adjacent to the mountains

This association is on uplands adjacent to the moun-

tains near Heart Butte. The topography consists of glacial moraines and dissected glacial outwash terraces. The parent material weathered mainly from limestone. Slopes are simple to complex. They range mainly from 2 to 35 percent, but in a few areas are as much as 60 percent. Elevation ranges from 4,300 to 5,200 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 2 percent of the survey area, or about 34,200 acres. It is about 30 percent Raynesford soils, 30 percent Whitore soils, and 20 percent Hanson soils. The remaining 20 percent is Bear Lake, Bridger, and Fifer soils.

Raynesford soils are mainly in concave areas. These soils are well drained. Typically, the surface layer is dark-gray gravelly loam 9 inches thick. The substratum is light-gray and pale-yellow, calcareous gravelly loam.

Whitore soils are on north-, east-, and west-facing side slopes. The soils are somewhat excessively drained. They typically have about 1 inch of forest litter on the surface. The mineral surface layer is dark-gray cobbly loam 2 inches thick. The subsoil is brown cobbly clay loam 5 inches thick. The substratum, to a depth of 60 inches, is light-gray and light olive-gray, calcareous cobbly clay loam that is about 45 percent cobbles and stones.

Hanson soils are mainly on south-facing side slopes and on knolls and ridgetops. These soils are well drained. Typically, the surface layer is dark grayish-brown stony loam 12 inches thick. The underlying material is light gray and white, calcareous very stony loam.

Poorly drained Bear Lake soils are in closed basins and swales. Bridger soils have a dark colored surface layer and a thick subsoil of brown clay loam; they are mainly associated with local areas of glacial till from sandstone. Fifer soils are underlain by shale or sandstone at a shallow depth.

Most areas of this association are used for range, woodland, and grazable woodland. Most of the Whitore soils have an overstory of limber and lodgepole pine, but there are some areas of Douglas-fir and aspen. The understory is bluebunch wheatgrass and fescue, Idaho fescue, forbs, and shrubs. The Raynesford and Hanson soils are mainly in range of bluebunch wheatgrass and rough fescue.

Dominantly Deep to Shallow, Well-Drained to Excessively Drained, Nearly Level to Very Steep Soils on Uplands

Sixteen soil associations are in this group. The soils of these associations are on glacial moraines, old stream and lake terraces, and dissected shale or sandstone uplands. The mean annual precipitation is 12 to 20 inches, elevation ranges from 3,500 to 6,000 feet, and the growing season is 60 to 110 days. These associations mainly are used as range and for dryland small grain crops; however, some areas are irrigated and used for small grain, hay, and tame pasture. Native vegetation is tall, mid, and short grasses.

6. Leavitt-Burnette association

Deep, nearly level to steep, well-drained loams, cobbly

loams, and stony loams formed in material derived from glacial till and old alluvium; on uplands

This association is northeast of Babb along the Canadian border and east of East Glacier Park. The topography consists of glacial moraines and glacial outwash terraces and fans. The parent material weathered from a variety of bedrock. Slopes are simple to complex; they range from 0 to 35 percent but are mainly 2 to 15 percent. Elevation ranges from 4,500 to 6,000 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 9 percent of the survey area, or about 153,800 acres. It is about 50 percent Leavitt soils and 20 percent Burnette soils. The remaining 30 percent is Adel and Nettleton soils.

Leavitt soils typically have a surface layer of very dark gray loam or cobbly loam 7 inches thick. The subsoil is grayish-brown clay loam 21 inches thick. The substratum is grayish-brown, calcareous clay loam.

Most areas of Burnette soils are east of East Glacier Park. Typically the surface layer is very dark grayish-brown loam or stony loam 15 inches thick. The subsoil is grayish-brown and olive-gray clay 17 inches thick. The substratum is gray and olive-gray clay.

Adel and Nettleton soils are mainly in concave areas. Adel soils are similar in texture to, and are associated with, Leavitt soils. Nettleton soils are similar in texture to, and are associated with, Burnette soils.

This association is used mainly for range. The major native grass is rough fescue. A few areas of this association are used for hay and tame pasture. A number of small lakes in areas of this association provide habitat for waterfowl, mainly during migration in fall and spring.

7. Hanson-Babb association

Deep, hilly and steep, well-drained stony and cobbly loams formed in material derived from glacial till; on uplands

This association is east of Duck Lake and west of Browning. The topography consists mainly of terminal moraines. The parent material is of mixed origin. Slopes are complex; they range from 2 to 35 percent but are mainly 8 to 35 percent. Elevation ranges from 4,500 to 6,000 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 3 percent of the survey area, or about 51,200 acres. It is about 50 percent Hanson soils and 40 percent Babb soils. The remaining 10 percent is Adel and Libeg soils.

Hanson soils are in areas on the tops of knolls and ridges and on south-facing side slopes. Typically, the surface layer is dark grayish-brown stony loam 12 inches thick. The underlying material is light-gray and white, calcareous very stony loam.

Babb soils are on north-, east-, and west-facing side slopes. Typically, the surface layer is black cobbly loam 7 inches thick. The subsoil is dark grayish-brown gravelly or cobbly loam 14 inches thick. The substratum is white, calcareous gravelly or cobbly loam.

Adel soils are in swales and basins. Libeg soils are similar to Hanson soils except that the underlying material is not calcareous.

This association is used mainly for range. The main

native grass is rough fescue, but bluebunch wheatgrass is common in some areas of Hanson soils.

8. *Michelson-Redchief-Pishkun association*

Deep, nearly level to very steep, well-drained to excessively drained cobbly and gravelly loams formed in old alluvium and material derived from glacial till; on dissected uplands

This association is around the headwaters of the Milk River. The topography consists of a series of nearly level to gently sloping terraces, remnants, and moderately sloping to very steep valley sides. The parent material is of mixed origin. Slopes range from 0 to 50 percent. Elevation ranges from 4,800 to 6,000 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 8 percent of the survey area, or about 136,800 acres. It is about 40 percent Michelson soils, 30 percent Redchief soils, and 15 percent Pishkun soils. The remaining 15 percent is Adel and Fifer soils.

Michelson soils are nearly level to moderately sloping. These soils are well drained. Typically, the surface layer is very dark grayish-brown cobbly loam 5 inches thick. The subsoil is yellowish-brown clay loam 13 inches thick. The upper part of the substratum is pink clay loam 20 inches thick, and the lower part is light brown very gravelly sandy clay loam and sandy clay.

Redchief soils are nearly level to moderately sloping. They are well drained. Typically, the surface layer is black and dark grayish-brown cobbly loam 7 inches thick. The upper part of the subsoil is yellowish-brown gravelly clay loam 6 inches thick, the middle part is strong-brown and yellowish-red gravelly clay 21 inches thick, and the lower part is light reddish-brown very gravelly clay 26 inches thick.

Pishkun soils are moderately steep to very steep. They are excessively drained. Typically, the surface layer is very dark grayish-brown and pale brown gravelly loam 10 inches thick. The substratum is light brownish-gray very gravelly loam.

Adel soils are in areas on foot slopes and in small pockets on the valley sides. Fifer soils, also on the valley sides, are loam that is shallow over shale.

This association is used mainly for range. The main native grass is rough fescue, but bluebunch wheatgrass is common in the areas of Pishkun soils. A few areas of the Michelson and Redchief soils are used for tame pasture.

9. *Fifer-Adel association*

Shallow and deep, hilly and steep, well-drained and somewhat excessively drained loams formed in materials weathered from shale; on uplands

This association is near the head of Milk River where stream dissection has removed the old alluvial mantle and cut into the underlying shale. The parent material weathered mainly from shale and fine-grained sandstone, but some of the material is remnants of the overlying alluvium. Slopes range mainly from 8 to 35 percent. Elevation ranges from 4,500 to 5,500 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 1.5 percent of the survey area, or about 25,600 acres. It is about 50 percent Fifer soils and 30 percent Adel soils. The remain-

ing 20 percent is Bynum, Cheadle, Michelson, and Pishkun soils.

Fifer soils are shallow over shale. They are somewhat excessively drained. Typically, the surface layer is dark-gray loam 6 inches thick. The underlying material is gray and greenish-gray silty clay loam that grades to greenish-gray shale at a depth of 20 inches.

Adel soils are deep and well drained. These soils are on foot slopes, in swales, and on north-facing side slopes. Typically, the surface layer is very dark gray loam 26 inches thick. The subsoil is dark grayish-brown loam 14 inches thick. The substratum is grayish-brown light clay loam.

Bynum soils are moderately deep over shale. Cheadle soils are shallow over sandstone. Michelson and Pishkun soils are deep and formed in remnants of old alluvium.

This association is used mainly for range. The major native grass is rough fescue.

10. *Michelson-Pishkun association*

Deep, nearly level to very steep, well-drained to excessively drained cobbly loams and gravelly loams formed in old alluvium; on dissected uplands

This association is in the north-central part of the survey area along the Canadian border. The topography mainly is a series of broad, smooth terraces dissected at intervals by deeply entrenched intermittent streams. The parent material weathered from a variety of bedrock. Slopes are simple to complex. They range from 0 to 50 percent. Elevation ranges from 4,400 to 4,800 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 2 percent of the survey area, or about 34,200 acres. It is about 70 percent Michelson soils and 15 percent Pishkun soils. The remaining 15 percent is Adel and Bynum soils.

Michelson soils are mainly nearly level to gently sloping, but in a few areas they are moderately sloping or moderately steep. They are well drained. Typically, the surface layer is very dark grayish-brown cobbly loam 13 inches thick. The upper part of the substratum is pink clay loam 20 inches thick, and the lower part is light brown very gravelly sandy clay loam and sandy clay.

Pishkun soils are moderately steep to very steep. They are excessively drained. Typically, the surface layer is very dark grayish-brown and pale-brown gravelly loam 10 inches thick. The underlying material is light brownish-gray very gravelly loam.

Adel soils are on foot slopes and in swales. Bynum soils are moderately deep over shale.

Most areas of this association are used for dryland small grain. Wetness during harvest and the possibility of frost are limitations for growing small grain. Some areas, mainly Pishkun soils, are used as range. The main native grasses are rough fescue and bluebunch wheatgrass.

11. *Timberg-Litimer-Kuro association*

Deep to shallow, gently sloping to hilly, well-drained clay loams and cobbly clay loams formed in material derived from red shale and alluvium; on dissected uplands

This association is in the central part of the survey

area. The topography consists of red shale uplands and adjacent stream terraces that were formed by material weathered from red shale and mixed with cobbly and gravelly alluvium from higher terraces. Slopes are short and complex or long and smooth; they range from 12 to 15 percent. Elevation ranges from 4,200 to 4,800 feet, and the mean annual precipitation is 14 to 16 inches.

This association occupies about 2 percent of the survey area, or about 34,200 acres. It is about 35 percent Timberg soils, 35 percent Litimber soils, and 15 percent Kuro soils. The remaining 15 percent is Farnuf, Reeder, and Rhoades soils and areas of Shale outcrop.

Timberg soils are moderately deep over shale and are gently sloping. Typically, the surface layer is brown clay loam 7 inches thick. The subsoil is reddish-brown clay loam and silty clay 14 inches thick. The substratum is reddish-brown silty clay that grades to light red shale at a depth of 32 inches.

Litimber soils are deep and are on fans and local terraces. Typically, the surface layer is 4 inches thick, the upper part is dark grayish-brown loam, and the lower part is reddish-brown clay loam. The subsoil is reddish-brown clay loam 13 inches thick. The substratum is pink and light reddish-brown clay loam.

Kuro soils are shallow over shale and are in south-facing areas and on the tops of ridges and knolls. Slopes are 4 to 15 percent. Typically, the surface layer is light reddish-brown clay loam 7 inches thick. The underlying material is weak-red and pale-yellow clay loam that grades to shale at a depth of 15 inches.

Farnuf and Reeder soils are similar to Litimber and Timberg soils except that they have a surface layer of loam and silt loam. Rhoades soils have a very slowly permeable subsoil and are in small areas on foot slopes and along intermittent streams.

This association is used mainly for range. The dominant native grasses are rough fescue, western wheatgrass, and green needlegrass. Some areas of this association are used for dryland small grain.

12. Farnuf-Cabba-Reeder association

Deep to shallow, nearly level to steep, well-drained cobbly loams, loams, and silt loams formed in old alluvium and material weathered from shale; on uplands

This association is in the north-central part of the survey area. The topography consists of dissected old alluvial terraces and shale uplands. Slopes are simple to complex. They range from 0 to 50 percent. Elevation ranges from 4,200 to 5,000 feet, and the mean annual precipitation is 14 to 16 inches.

This association occupies about 5 percent of the survey area, or about 85,500 acres. It is about 50 percent Farnuf soils, 20 percent Cabba soils, and 10 percent Reeder soils. The remaining 20 percent is Arnegard soils and areas of Terrace escarpments, Saline land, and Shale outcrop.

Farnuf soils are deep and mainly nearly level to moderately sloping. Typically, the surface layer is dark grayish-brown cobbly loam 4 inches thick. The subsoil is brown clay loam 12 inches thick. The substratum is light brownish-gray light clay loam and gravelly sandy loam.

Cabba soils are shallow over shale and are undulating

to steep. Typically, the surface layer is grayish-brown heavy loam 3 inches thick. The underlying material is light brownish-gray and white loam that grades to soft shale at a depth of 18 inches.

Reeder soils are moderately deep over shale and are undulating or rolling. Typically, the surface layer is dark grayish-brown silt loam 6 inches thick. The subsoil is brown silty clay loam 11 inches thick. The substratum is light-gray silt loam that grades to shale at a depth of 38 inches.

Arnegard soils are on foot slopes and in swales. Terrace escarpments, Saline land, and Shale outcrop are steep and very steep land types.

This association is used mainly for range, but some areas are used for dryland small grain and tame pasture. The dominant native grasses are rough fescue and bluebunch wheatgrass.

13. Raynesford-Hanson association

Deep, undulating to steep, well-drained gravelly and stony loams formed in material derived from glacial till; on uplands

This association is in the glacial uplands north and east of Heart Butte. The topography mainly consists of broad, rolling and hilly glacial moraines. There are also some steep valley sides. The parent material weathered mainly from limestone. Slopes are complex. They range from 2 to 35 percent. Elevation ranges from 4,000 to 5,000 feet, and the mean annual precipitation is 15 to 20 inches.

This association occupies about 3 percent of the survey area, or about 51,200 acres. It is about 45 percent Raynesford soils and 35 percent Hanson soils. The remaining 20 percent is Bear Lake, Bynum, Castner, and Utica soils.

Raynesford soils mainly are on foot slopes, in swales, and on north-facing side slopes. Typically, the surface layer is dark-gray and dark grayish-brown gravelly loam 9 inches thick. The underlying material is light-gray and pale-yellow, calcareous gravelly loam.

Hanson soils are on the tops of ridges and knolls and on south-facing side slopes. Typically, the surface layer is dark grayish-brown stony loam 12 inches thick. The underlying material is light-gray and white, calcareous very stony loam.

Poorly drained Bear Lake soils are in basins. Bynum soils are silt loam that is moderately deep over shale. Castner soils are shallow over hard sandstone. Utica soils are very gravelly soils and are on glacial outwash terraces.

Most areas of this association are used for range. The dominant native grasses are rough fescue and bluebunch wheatgrass. Creeping juniper, a prostrate shrub, is common in areas of this association.

14. Fairfield-Cabba-Martinsdale association

Deep, nearly level to moderately sloping, well-drained gravelly loams, loams, and gravelly clay loams formed in old alluvium and shallow, rolling to very steep loams formed in material weathered from shale; on uplands

This association is in the central part of the survey area. The topography consists of old alluvial terraces that are dissected by streams. Slopes are long and smooth or short and complex. They range from 0 to 15

percent. Elevation ranges from 3,800 to 4,500 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 9.5 percent of the survey area, or about 162,400 acres. It is about 30 percent Fairfield soils, 25 percent Cabba soils, and 20 percent Martinsdale soils. The remaining 25 percent is Absher, Castner, and Wayden soils and areas of Terrace escarpments, Saline land, and Wet land.

Fairfield soils are deep and mainly nearly level to moderately sloping. Typically, the surface layer is dark-gray gravelly loam 4 inches thick. The subsoil is brown gravelly clay loam 6 inches thick. The substratum is mostly white, calcareous clay loam to a depth of 60 inches.

Cabba soils are shallow over shale, are rolling to very steep and are on valley sides. Typically, the surface layer is grayish-brown heavy loam 3 inches thick. The underlying material is light brownish-gray and white loam that grades to soft shale at a depth of 18 inches.

Martinsdale soils are deep and mainly gently sloping to moderately steep. Typically, the surface layer is grayish-brown gravelly clay loam 6 inches thick. The subsoil is dark grayish-brown and light-gray gravelly clay loam 18 inches thick. The substratum is light-gray and white gravelly clay loam and gravelly sandy clay loam.

Absher soils have a very slowly permeable subsoil. Castner and Wayden soils are shallow over sandstone and over shale, respectively. Terrace escarpments, Saline land, and Wet land are steep and very steep land types.

Most areas of the Fairfield and Martinsdale soils in the association are used for dryland small grain. Some areas of these soils have good potential for irrigation. The rest of the association is used for range. The main native grass is bluebunch wheatgrass.

15. Fairfield-Martinsdale association

Deep, nearly level to moderately sloping, well-drained gravelly loams and loams formed in old alluvium; on terraces in the uplands

This association is in the central and northeastern parts of the survey area. The topography consists of old terraces that have had little stream dissection, and it includes the edges of steep terraces and adjacent valley sides. Slopes are long and smooth and range from nearly level to moderately sloping, but they are mostly nearly level or gently sloping. They range from 0 to 8 percent. Elevation ranges from 3,800 to 4,500 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 12 percent of the survey area, or about 205,100 acres. It is about 50 percent Fairfield soils and 25 percent Martinsdale soils. The remaining 25 percent is mainly Terrace escarpments and some areas of Wet land, Saline land, and Rock outcrop.

Fairfield soils typically have a surface layer of dark-gray gravelly loam 4 inches thick. The subsoil is brown gravelly clay loam 6 inches thick. The substratum is mostly white, calcareous clay loam to a depth of 60 inches.

Martinsdale soils typically have a surface layer of grayish-brown loam 6 inches thick. The subsoil is dark grayish-brown clay loam 18 inches thick. The sub-

stratum is light-gray and white gravelly clay loam and gravelly sandy clay loam.

Terrace escarpments are mainly steep and very steep.

This association is used mainly for dryland and irrigated crops. The Two Medicine Irrigation Project, an area of about 15,000 acres west of Cut Bank, mainly is made up of areas of Fairfield soils. The main dryland crop is small grain, and the main irrigated crops are hay, pasture, and small grain. Large areas of this association have potential for development through irrigation.

16. Williams-Zahl association

Deep, undulating to steep, well-drained and excessively drained cobbly loams and loams formed in glacial till; on uplands

This association is in the south-central part of the survey area. The topography consists of glacial moraines and minor glacial outwash terraces and fans. The parent material is from mixed rock sources. Slopes are complex. They range from 2 to 35 percent. Elevation ranges from 4,000 to 4,600 feet, and the mean annual precipitation is 14 to 16 inches.

This association occupies about 9 percent of the survey area, or about 153,800 acres. It is about 70 percent Williams soils and 20 percent Zahl soils. The remaining 10 percent is Arnegard and Beaverton soils.

Williams soils are well drained and are in areas throughout the association, except on the tops of ridges and knolls and on steep south-facing side slopes. Typically, the surface layer is dark-gray cobbly loam 3 inches thick. The subsoil is dark-brown and grayish-brown clay loam 18 inches thick. The substratum is grayish brown clay loam.

Zahl soils are excessively drained soils and are on the tops of knolls and ridges and on south-facing side slopes. Typically, the surface layer is dark grayish-brown cobbly loam 5 inches thick. The underlying material is mainly grayish-brown gravelly loam.

The well-drained Arnegard soils are on foot slopes and in swales. Beaverton soils are on the outwash terraces and fans. They have a very gravelly subsoil and substratum.

Most areas of this association are used for range. The dominant native grass is bluebunch wheatgrass. Some areas of this association are used for small grain, and many other areas are suited to this use.

17. Pendroy-Ethridge-Linnet association

Deep, nearly level to moderately sloping, well-drained clays and silty clay loams formed in glacial lake sediment; on old glacial lake plains in the uplands

This association is north and south of the town of Cut Bank. The topography consists of a large glacial lake plain broken by the narrow, deeply entrenched valleys of Cut Bank, Two Medicine, and Birch Creeks. Slopes are simple and mainly long and smooth. They range from 0 to 8 percent. Elevation ranges from 3,600 to 4,000 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 6.5 percent of the survey area, or about 111,100 acres. It is about 30 percent Pendroy soils, 30 percent Ethridge soils, and 20

percent Linnet soils. The remaining 20 percent is Brockway and Scobey soils.

Pendroy soils typically have a surface layer of light brownish-gray clay 5 inches thick. The underlying material is light brownish-gray and olive clay.

Ethridge soils typically have a surface layer of grayish-brown silty clay loam 5 inches thick. The subsoil is dark grayish-brown silty clay 12 inches thick. The substratum is stratified, very pale brown fine sand to clay, but it is mostly silty clay loam.

Linnet soils typically have a surface layer of dark grayish-brown clay 3 inches thick. The subsoil is grayish-brown clay 11 inches thick. The substratum is grayish-brown, calcareous clay. In some areas gravel and sand are below a depth of about 42 inches.

Brockway soils have a surface layer of silt loam. Scobey soils are undulating and rolling and are clay loam.

Most areas of this association are used for cultivated crops. The most common crop is dryland small grain. A few small areas are used for range. The soils in areas of the Badger-Fish Irrigation Project in Pondera County are used for hay, tame pasture, and small grain.

18. Boxwell-Tanna-Wayden association

Moderately deep and shallow, undulating to hilly, well-drained and excessively drained silt loams, clay loams, and loams formed in material weathered from interbedded shale and soft sandstone; on uplands

This association is in the northeastern part of the survey area. The topography consists of a dissected shale upland. Slopes are complex. They range from 2 to 35 percent. Elevation ranges from 3,800 to 4,200 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 2 percent of the survey area, or about 34,200 acres. It is about 30 percent Boxwell soils, 30 percent Tanna soils, and 20 percent Wayden soils. The remaining 20 percent is Absher, Cabba, and Ethridge soils.

Boxwell soils are moderately deep, well-drained, and undulating and rolling. Typically the surface layer is grayish-brown silt loam 5 inches thick. The subsoil is brown and grayish-brown silty clay loam 9 inches thick. The substratum is white silt loam to a depth of 28 inches and soft shale below that depth.

Tanna soils are moderately deep, well drained, and undulating to hilly. Typically, the surface layer is grayish-brown clay loam 7 inches thick. The subsoil is grayish-brown silty clay and clay loam 17 inches thick. The substratum is light brownish-gray heavy clay loam to a depth of 38 inches and soft, platy shale below that depth.

Wayden soils are shallow, excessively drained, and rolling and hilly. Typically, the surface layer is grayish-brown clay loam 6 inches thick. The underlying material is light-gray silty clay to a depth of 18 inches and shale below that depth.

Absher soils have a very slowly permeable subsoil. Cabba soils are loam that is shallow over shale. Ethridge soils are deep, gently sloping clay loams and are on fans and terraces.

Most areas of this association are used for dryland small grain, but some areas are used for tame pasture or for range. The dominant native grasses are western

wheatgrass, green needlegrass, and bluebunch wheatgrass.

19. Attewan-Ethridge-Tally association

Deep, nearly level to moderately sloping, well-drained sandy loams, silty clay loams, and loams formed in alluvium; on alluvial fans and terraces in the uplands

This association mainly is along Rocky Coulee north of Cut Bank. The topography consists of stream terraces and lake sediment derived mainly from reworking of glacial till. Slopes are simple. They range from 0 to 20 percent. Elevation ranges from 3,600 to 4,300 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 1 percent of the survey area, or about 17,500 acres. It is about 60 percent Attewan soils, 15 percent Ethridge soils, and 15 percent Tally soils. The remaining 10 percent is Absher and Yetull soils.

Attewan soils typically have a surface layer of grayish-brown sandy loam 5 inches thick. The subsoil is grayish-brown sandy clay loam 10 inches thick. The substratum is grayish-brown sandy clay loam to a depth of 28 inches and red, black, and brown sand below that depth.

Ethridge soils typically have a surface layer of grayish-brown silty clay loam 5 inches thick. The subsoil is dark grayish-brown silty clay 12 inches thick. The substratum is stratified very pale brown fine sand, silt, and clay, but it is mostly silty clay loam.

Tally soils typically have a surface layer of dark grayish-brown sandy loam 4 inches thick. The subsoil is dark-brown sandy loam 10 inches thick. The substratum is grayish-brown and brown sandy loam to a depth of 42 inches and light brownish-gray sand below that depth.

Absher soils have a very slowly permeable subsoil and are mainly near Ethridge soils along intermittent streams. Yetull soils are deep over sand and are mainly in small areas among Attewan and Tally soils.

Most areas of this association are used for dryland small grain. A few areas are used for tame pasture or range.

20. Scobey-Kevin-Zahl association

Deep, undulating to steep, well-drained and excessively drained loams and clay loams formed in material derived from glacial till; on uplands

This association is in the northeastern and eastern parts of the survey area. The topography consists of terminal and ground moraines and local outwash fans and terraces. Slopes are mainly complex, but in places they are long and gently sloping to moderately sloping. They range from 2 to 35 percent. The parent material is from mixed sources. Elevation ranges from 3,600 to 4,300 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 6 percent of the survey area, or about 102,600 acres. It is about 50 percent Scobey soils, 30 percent Kevin soils, and 10 percent Zahl soils. The remaining 10 percent is Arnegard and Nishon soils.

Scobey soils are well drained and undulating to hilly. Typically, the surface layer is gray loam 3 inches thick.

The subsoil is grayish-brown and brown clay loam 12 inches thick. The substratum is grayish-brown and gray clay loam.

Kevin soils are well drained and undulating to hilly. Typically, the surface layer is grayish-brown loam 6 inches thick. The subsoil is light brownish-gray clay loam 4 inches thick. The substratum is light gray and grayish-brown clay loam and silty clay loam.

Zahl soils are excessively drained and hilly to steep. Typically, the surface layer is dark grayish-brown clay loam 5 inches thick. The underlying material is grayish-brown and light olive-gray clay loam and gravelly loam.

Arnegard soils are well drained and are on foot slopes and in swales. Nishon soils are poorly drained and frequently ponded and are in very small to large swales and closed basins.

Most areas of the undulating and rolling soils of this association are used for dryland small grain. A few of these areas along the Canadian border are used for range, as are most of the areas of hilly and steep soils. A few areas of this association are used for tame pasture. The dominant native grass is bluebunch wheatgrass.

21. Cabba-Wayden association

Shallow, rolling to steep, well-drained and excessively drained loams and clay loams formed in material weathered from shale; on uplands

This association is in the eastern half of the survey area. The topography consists of dissected uplands, mainly of shale but also some sandstone. Slopes are complex. They range from 4 to 45 percent. Elevation ranges from 3,600 to 4,600 feet, and the mean annual precipitation is 12 to 14 inches.

This association occupies about 3.5 percent of the survey area, or about 59,800 acres. It is about 40 percent Cabba soils and 40 percent Wayden soils. The remaining 20 percent is 10 percent Rentsac, Boxwell, and Tanna soils, and 10 percent areas of Rock outcrop.

Cabba soils are well drained. Typically, the surface layer is grayish-brown heavy loam 3 inches thick. The underlying material is light brownish-gray and white loam that grades to soft shale at a depth of 18 inches.

Wayden soils are excessively drained. Typically, the surface layer is grayish-brown clay loam 6 inches thick. The underlying material is light-gray silty clay to a depth of 18 inches and shale below that depth.

Rentsac soils are shallow over sandstone. Boxwell and Tanna soils are moderately deep over shale and are near Cabba soils and Wayden soils, respectively. The small areas of Rock outcrop are shale and sandstone and are nearly barren of vegetation.

Most areas of this association are used for range. The dominant native grass is western wheatgrass. A few areas of gently sloping and undulating soils are used for tame pasture.

Dominantly Deep and Shallow, Somewhat Excessively Drained to Poorly Drained, Nearly Level to Very Steep Soils on Valley Sides, Bottom Lands, and Basins

Three soil associations are in this group. The soils of these associations contrast with soils in the surrounding

areas in character and usefulness. The soils on valley sides formed in material weathered from sandstone and shale. The soils on bottom lands formed in mixed alluvial material. The soils in basins formed in deep, strongly alkaline clay and clay loam alluvium and in lake sediment. Mean annual precipitation is 12 to 20 inches, elevation ranges from 3,400 to 4,800 feet, and the growing season is 60 to 110 days. The soils in these associations are used mainly for range, but a few areas are used for hay, tame pasture, and small grain.

22. Gallatin-Beaverton-Novary association

Deep, nearly level and gently sloping, well-drained to poorly drained loams and gravelly loams; on bottom lands

This association is on bottom lands adjacent to the major streams in the survey area. The parent material is alluvium from mixed sources. Some of the soils are underlain by very gravelly sand below a depth of 20 inches. Slopes are simple. They range from 0 to 4 percent. Elevation ranges from 3,600 to 4,800 feet, and the mean annual precipitation is 14 to 20 inches.

This association occupies about 3 percent of the survey area, or about 51,200 acres. It is about 35 percent Gallatin soils, 35 percent Beaverton soils, and 20 percent Novary soils. The remaining 10 percent is Bear Lake, Bearmouth, and Tinsley soils. The valley of the South Fork of Milk River is about 70 percent Gallatin and Novary soils and only 10 percent Beaverton soils.

Gallatin soils are deep, somewhat poorly drained, and nearly level. Typically, the surface layer is dark-gray loam 38 inches thick. The underlying material is light-gray stratified loam, sandy loam, and silty clay loam.

Beaverton soils are well drained, are nearly level to gently sloping, and are on stream terraces. Typically, the surface layer is grayish-brown gravelly loam 2 inches thick. The subsoil is dark grayish-brown gravelly clay loam and very gravelly clay loam 12 inches thick. The substratum is grayish-brown very gravelly loamy sand and very gravelly sand.

Novary soils are deep, are poorly drained, are nearly level and are on bottom lands. Typically, the surface layer is dark-gray and gray loam and silt loam 26 inches thick. The underlying material is stratified silt loam, silty clay loam, and sandy loam.

Bear Lake soils are deep and poorly drained and have a calcareous substratum. Bearmouth soils mainly are in the Saint Mary River Valley. They are similar to Beaverton soils but have a subsoil of very gravelly loam. Tinsley soils are very gravelly sand below a depth of about 12 inches.

Areas of this association are used mainly for range. A few areas are used for tame pasture, irrigated hay, and small grain. Many areas can be improved through drainage, reseeding, irrigation, and range management.

23. Vanda-Absher-Saline land association

Deep, nearly level and gently sloping, well-drained and poorly drained clays or clay loams; in basins

This association is in the eastern part of the survey area. The topography consists mainly of large depressions and nearly level intermittent stream valleys. The parent material is strongly alkaline clay and clay loam

alluvium and lake sediment. Slopes are simple. They range from 0 to 4 percent. The mean annual precipitation is 12 to 14 inches.

This association occupies about 1 percent of the survey area, or about 17,100 acres. It is about 50 percent Vanda soils, 20 percent Absher soils, and 20 percent Saline land. The remaining 10 percent is Pendroy soils and Playas.

Vanda soils typically have a surface layer of light brownish-gray clay 5 inches thick. The underlying material is light olive-gray, alkaline clay.

Absher soils mainly are near Little Rocky Coulee in the east-central part of the survey area. Typically, the surface layer is light-gray and dark grayish-brown loam and clay loam 2 inches thick. The subsoil is grayish-brown clay loam 12 inches thick. The substratum is strongly alkaline, light brownish-gray clay loam.

Saline land, a miscellaneous land type, is mainly deep clay loams that are poorly drained and moderately to strongly saline. Saline land is in all areas of this association.

Pendroy soils are deep, moderately alkaline clay. Playas are nearly barren clay.

This association is suited to range. Careful management to prevent overuse or grazing when the soil is wet helps to maintain good surface condition and prevents ponding and runoff.

24. Cabba-Rentsac-Rock outcrop association

Shallow, steep and very steep, well-drained to excessively drained loams and stony loams formed in material weathered from shale and sandstone; on valley sides

This association is on the sides of valleys of deeply entrenched major streams in the uplands of the survey area. The parent material weathered mainly from sandstone and shale, but in places the bedrock has a thick mantle of alluvium or glacial till. Slopes are complex. They range from 15 to 60 percent. The mean annual precipitation is 12 to 15 inches. The growing season is 90 to 110 days.

This association occupies about 2 percent of the survey area, or about 34,200 acres. It is about 30 percent Cabba soils, 30 percent Rentsac soils, and 30 percent Rock outcrop. The remaining 10 percent is Sunburst soils and areas of Mixed alluvial land.

Cabba soils are shallow over shale. Typically, the surface layer is grayish-brown heavy loam 3 inches thick. The underlying material is light brownish-gray and white loam that grades to soft shale at a depth of 18 inches.

Rentsac soils are shallow over sandstone. Typically, the surface layer is light brownish-gray stony loam 3 inches thick. The underlying material is light yellowish-brown stony loam and stony sandy loam. Hard sandstone is at a depth of 18 inches.

Rock outcrop of both sandstone and shale is steep and very steep in small and rather large areas throughout the valley sides. These areas are nearly barren.

Sunburst soils are deep clay and formed in the glacial till on mantled valley sides. Mixed alluvial land is narrow strips of alluvium along the streams.

Areas of this association are used mainly for range, although some areas are inaccessible to livestock. Runoff is very rapid, and geologic erosion is active. Careful grazing management is needed.

Descriptions of the Soils

This section describes the soil series and mapping units in the Area. Each soil series is described in detail, and then, briefly, each mapping unit in that series. 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 description 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, which 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 much 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 differences that 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 soil series. Riverwash and Badland, for example, do not belong to a soil series, but nevertheless, are listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit or subclass, range site, and woodland group or windbreak suitability group in which the mapping unit has been placed. The page for the description of each capability unit or subclass, range site, windbreak suitability group, or other interpretative group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Mapping units in the survey area are placed into groups of medium intensity or low intensity, according to the expected degree of land use and the relative uniformity of soil within the mapping unit. Units of medium intensity have an intensive land use and are mainly phases of soils in a series and soil complexes that have a uniform soil pattern and consist of soils that do not contrast. Units of low intensity have less intensive land use and are mainly soil associations, undifferentiated groups, and land types.

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 (10).¹

¹ Italic numbers in parentheses refer to Literature Cited, p. 158.

TABLE 1.—Approximate acreage and proportionate extent of the soils

Map symbol	Soil	Acres	Percent	Map symbol	Soil	Acres	Percent
Ac	Absher complex -----	21,880	1.3	Eg	Ethridge silty clay loam, 0 to 2 percent slopes -----	5,960	0.3
Ad	Adel loam, 0 to 4 percent slopes --	1,490	.1	Eh	Ethridge silty clay loam, 2 to 4 percent slopes -----	6,430	.4
Ae	Adel loam, 4 to 10 percent slopes --	1,960	.1	Em	Ethridge-Absher clay loams, 0 to 2 percent slopes -----	11,760	.7
AB	Adel-Babb complex, hilly -----	13,370	1.3	Fa	Fairfield loam, 0 to 2 percent slopes -----	460	(¹)
AF	Adel-Fifer association, hilly -----	16,040	.9	Fb	Fairfield loam, 2 to 4 percent slopes -----	6,660	.4
AL	Adel-Hanson complex, hilly -----	3,740	.2	Fc	Fairfield loam, 4 to 8 percent slopes -----	3,310	.2
Ag	Arnegard loam, 0 to 2 percent slopes -----	1,260	.1	Fd	Fairfield gravelly loam, 0 to 2 percent slopes -----	35,580	2.1
Ah	Arnegard loam, 2 to 8 percent slopes -----	1,090	.1	Fe	Fairfield gravelly loam, 2 to 4 percent slopes -----	28,000	1.6
Ak	Attewan sandy loam, 0 to 4 percent slopes -----	8,080	.5	Ff	Fairfield gravelly loam, 4 to 8 percent slopes -----	28,220	1.7
Am	Attewan sandy loam, 4 to 8 percent slopes -----	3,820	.2	Fg	Fairfield cobbly loam, 0 to 4 percent slopes -----	800	(¹)
An	Attewan loam, 0 to 4 percent slopes -----	1,750	.1	Fh	Fairfield-Cabba complex, sloping--	2,360	.1
Ao	Attewan loam, 4 to 8 percent slopes -----	1,270	.1	Fk	Fairfield-Utica gravelly loams, 0 to 2 percent slopes -----	1,800	.1
Ba	Babb cobbly loam, undulating -----	1,650	.1	Fm	Farnuf loam, 0 to 2 percent slopes--	940	(¹)
Bb	Babb cobbly loam, gently rolling --	9,290	.5	Fn	Farnuf cobbly loam, 0 to 2 percent slopes -----	1,550	.1
BC	Babb cobbly loam, hilly -----	13,750	.8	Fo	Farnuf cobbly loam, 2 to 4 percent slopes -----	9,270	.5
BF	Babb-Hanson complex, hilly -----	44,410	2.6	Fr	Farnuf cobbly loam, 4 to 8 percent slopes -----	20,650	1.2
Bd	Babb sandy loam, sandy subsoil variant, undulating -----	1,480	.1	Fs	Farnuf cobbly loam, 8 to 15 percent slopes -----	1,210	.1
BG	Babb sandy loam, sandy subsoil variant, hilly -----	1,150	.1	Ft	Fifer loam, hilly -----	3,330	.2
BL	Badland -----	4,550	.3	FU	Fifer-Cheadle-Rock outcrop complex, very steep -----	14,220	.3
Be	Bear Lake silty clay loam -----	4,630	.3	FV	Fifer-Raynesford complex, hilly --	1,930	.1
Bg	Bearmouth gravelly loam, 0 to 4 percent slopes -----	6,100	.4	FW	Fresh water swamp -----	3,410	.2
Bh	Beaverton gravelly loam, 0 to 4 percent slopes -----	13,550	.8	Ga	Gallatin loam -----	2,040	.1
Bk	Beaverton-Williams complex, undulating -----	740	(¹)	Gc	Gapo clay loam -----	1,720	.1
Bo	Boxwell complex, undulating -----	17,420	1.0	Gd	Gapo clay loam, drained -----	1,470	.1
BM	Bridger-Mord association, hilly --	2,910	.2	GL	Garlet stony loam, very steep -----	6,890	.4
BN	Bridger-Rock land association, very steep -----	3,970	.2	HA	Hanson stony loam, steep -----	10,490	.6
Br	Brockway silt loam, 0 to 2 percent slopes -----	2,880	.2	HF	Hanson-Fifer complex, rolling --	2,430	.1
Bs	Brockway silt loam, 2 to 4 percent slopes -----	4,610	.3	HR	Hanson-Raynesford complex, undulating -----	9,040	.5
Bt	Brockway silt loam, 4 to 8 percent slopes -----	2,530	.1	HS	Hanson-Raynesford complex, rolling -----	15,120	.9
BP	Burnette stony loam, hilly -----	20,450	1.2	Ka	Kevin loam, 2 to 4 percent slopes--	1,380	.1
Bu	Burnette loam, undulating -----	630	(¹)	Kb	Kevin loam, 4 to 8 percent slopes--	1,830	.1
BW	Burnette-Adel association, rolling--	7,090	.4	Kc	Kevin clay loam, 2 to 4 percent slopes -----	1,630	.1
Bv	Bynum silt loam, undulating -----	4,550	.3	Kd	Kevin clay loam, 4 to 8 percent slopes -----	2,040	.1
By	Bynum-Fifer complex, rolling -----	1,650	.1	Ke	Kevin clay loam, 8 to 15 percent slopes -----	900	(¹)
Ca	Cabba loam, undulating -----	12,880	.8	Kq	Kiev loam, 2 to 4 percent slopes--	2,310	.1
Cb	Cabba loam, hilly -----	24,620	1.5	Kh	Kiev loam, shale substratum, 2 to 4 percent slopes -----	1,230	.1
Ce	Cabba-Reeder complex, undulating -----	6,500	.4	Kk	Kiev loam, shale substratum, 4 to 8 percent slopes -----	7,010	.4
CK	Cabba-Rock outcrop complex, very steep -----	12,960	.8	Km	Kiev loam, shale substratum, 8 to 15 percent slopes -----	870	(¹)
Cn	Castner-Cabba complex, sloping --	4,620	.3	Kn	Kiev gravelly loam, 0 to 2 percent slopes -----	1,120	.1
Co	Castner-Cabba complex, steep -----	3,010	.2	Ko	Kiev gravelly loam, 2 to 4 percent slopes -----	4,460	.3
CR	Castner-Rock outcrop complex, very steep -----	2,820	.2	Kp	Kiev gravelly loam, 4 to 8 percent slopes -----	6,200	.4
CV	Crago-Kiev association, steep -----	13,300	.8	Kr	Kiev gravelly loam, 8 to 15 percent slopes -----	1,080	(¹)
Dc	Dimmick clay -----	1,100	.1	Ks	Kiwanis fine sandy loam -----	1,640	.1
DH	Doby-Burnette complex, hilly -----	7,020	.4				
DL	Doby-Hanson complex, rolling -----	1,620	.1				
DS	Doby-Shale outcrop complex, very steep -----	6,530	.4				
DU	Dune land -----	290	(¹)				
Ec	Ethridge clay loam, sand substratum, 0 to 2 percent slopes --	1,460	.1				
Ed	Ethridge clay loam, sand substratum, 2 to 4 percent slopes --	8,840	.5				
Ee	Ethridge clay loam, sand substratum, 4 to 8 percent slopes --	1,690	.1				

TABLE 1.—Approximate acreage and proportionate extent of the soils—Continued

Map symbol	Soil	Acres	Percent	Map symbol	Soil	Acres	Percent
Kt	Korchea loam, 0 to 2 percent slopes	8,880	0.5	Mw	Michelson cobbly loam, 8 to 15 percent slopes	4,210	0.2
Ku	Korchea loam, 2 to 4 percent slopes	870	(¹)	Mx	Michelson stony loam, 0 to 4 percent slopes	1,220	.1
KV	Korchea and Kiwanis soils	4,770	.3	My	Mikesell clay loam, hilly	1,650	.1
Kw	Kuro-Timberg complex, rolling	4,160	.2	MZb	Mixed alluvial land	11,590	.7
La	Leavitt cobbly loam, 0 to 2 percent slopes	1,250	.1	Mz	Mord loam, sloping	1,110	.1
Lb	Leavitt cobbly loam, 2 to 4 percent slopes	7,760	.5	MZc	Mord stony loam, steep	6,170	.4
Lc	Leavitt cobbly loam, 4 to 8 percent slopes	13,320	.8	NB	Nettleton-Burnette association, undulating	3,070	.2
Ld	Leavitt cobbly loam, 8 to 15 percent slopes	1,700	.1	NM	Nettleton and Mikesell clay loams, hilly	6,620	.4
Le	Leavitt complex, undulating	21,800	1.3	Nc	Nishon clay loam	2,230	.1
LF	Leavitt complex, hilly	41,970	2.5	No	Novary loam	7,490	.4
LG	Libeg stony loam, very steep	5,080	.3	PA	Peat	320	(¹)
LH	Libeg-Adel complex, rolling	1,230	.1	Pc	Pendroy clay, 0 to 2 percent slopes	8,230	.5
Lk	Linnet clay, 0 to 2 percent slopes	4,300	.2	Pd	Pendroy clay, 2 to 4 percent slopes	20,400	1.2
Lm	Linnet clay, 2 to 4 percent slopes	9,390	.5	Pe	Pendroy clay, 4 to 8 percent slopes	4,130	.2
Ln	Linnet clay, 4 to 8 percent slopes	4,830	.3	Pf	Pendroy clay, shale substratum	4,510	.3
Lo	Linnet clay, gravelly substratum, 0 to 2 percent slopes	2,010	.1	PH	Pishkun-Adel association, steep	68,190	3.8
Lp	Linnet clay, gravelly substratum, 2 to 4 percent slopes	900	(¹)	PL	Playas	530	(¹)
Lr	Litimber clay loam, 2 to 4 percent slopes	1,420	.1	RC	Raynesford-Bear Lake complex, rolling	2,700	.2
Ls	Litimber clay loam, 4 to 8 percent slopes	1,760	.1	RD	Raynesford-Hanson complex, hilly	4,830	.3
Lt	Litimber cobbly clay loam, undulating	2,840	.2	Re	Redchief cobbly loam, gently sloping	10,540	.6
Lu	Litimber complex, 2 to 8 percent slopes	4,500	.3	Rf	Redchief cobbly loam, sloping	1,390	.1
LV	Loberg-Mord association, hilly	9,220	.5	Rg	Reeder silt loam, undulating	8,050	.5
LW	Loberg-Whitore association, very steep	9,820	.6	Rh	Reeder-Arnegard complex, undulating	3,320	.2
LY	Loberg soils, hilly	23,910	1.4	RK	Rentsac-Rock outcrop complex, very steep	8,030	.5
Ma	Martinsdale loam, 0 to 2 percent slopes	420	(¹)	Rm	Rentsac stony loam, undulating	2,790	.2
Mb	Martinsdale loam, 2 to 4 percent slopes	7,630	.4	Rn	Rentsac stony loam, rolling	1,210	(¹)
Mc	Martinsdale loam, 4 to 8 percent slopes	5,980	.3	Ro	Rhoades complex	18,080	1.1
Md	Martinsdale gravelly loam, 2 to 4 percent slopes	1,560	.1	RS	Riverwash	600	(¹)
Me	Martinsdale clay loam, 0 to 2 percent slopes	490	(¹)	RT	Rock outcrop	4,280	.2
Mf	Martinsdale clay loam, 2 to 4 percent slopes	5,210	.3	SA	Saline land	29,150	1.7
Mg	Martinsdale clay loam, 4 to 8 percent slopes	7,760	.5	Sb	Savage clay loam, 0 to 2 percent slopes	1,040	.1
Mh	Martinsdale clay loam, 8 to 15 percent slopes	590	(¹)	Sc	Savage clay loam, 2 to 4 percent slopes	4,200	.2
Mk	Martinsdale gravelly clay loam, 0 to 2 percent slopes	4,650	.3	Sd	Savage clay loam, undulating	7,120	.4
Mm	Martinsdale gravelly clay loam, 2 to 4 percent slopes	12,300	.7	Se	Savage-Rhoades clay loams, 0 to 4 percent slopes	4,900	.3
Mn	Martinsdale gravelly clay loam, 4 to 8 percent slopes	17,360	1.0	Sf	Savage-Wayden clay loams, rolling	1,140	.1
Mo	Michelson loam, 0 to 2 percent slopes	4,220	.2	Sg	Scobey clay loam, 2 to 4 percent slopes	11,208	.7
Mp	Michelson loam, 2 to 4 percent slopes	1,570	.1	Sh	Scobey clay loam, 4 to 8 percent slopes	4,440	.3
Mr	Michelson loam, 4 to 8 percent slopes	2,610	.1	Sk	Scobey-Kevin loams, undulating	33,690	2.0
Ms	Michelson loam, 8 to 15 percent slopes	870	(¹)	Sm	Scobey-Kevin loams, rolling	35,540	2.1
Mt	Michelson cobbly loam, 0 to 2 percent slopes	10,630	.6	Sn	Scobey-Kevin clay loams, undulating	3,000	.2
Mu	Michelson cobbly loam, 2 to 4 percent slopes	8,910	.5	SO	Scobey-Zahl complex, hilly	13,900	.8
Mv	Michelson cobbly loam, 4 to 8 percent slopes	18,270	1.1	SP	Seeped alluvial land	10,780	.6
				Sr	Sherburne gravelly loam, sloping	3,760	.2
				SS	Sherburne gravelly loam, steep	410	(¹)
				ST	Stony land	790	(¹)
				SU	Sunburst clay, steep	13,000	.8
				SV	Swifton-Mikesell association, hilly	2,740	.2
				SW	Swifton-Mord-Rock land association, very steep	7,750	.5
				SX	Swifton-Garlet association, hilly	4,430	.3
				Ta	Tally sandy loam, 0 to 2 percent slopes	1,530	.1

TABLE 1.—Approximate acreage and proportionate extent of the soils—Continued

Map symbol	Soil	Acres	Percent	Map symbol	Soil	Acres	Percent
Tb	Tally sandy loam, undulating ----	1,850	0.1	Wc	Wayden-Absher complex, undulating -----	3,260	0.2
Tc	Tally sandy loam, rolling -----	1,840	.1	WD	Wayden-Shale outcrop complex, steep -----	12,680	.7
TD	Tally complex, sloping -----	4,350	.3	WE	Wet alluvial land -----	1,550	.1
Te	Tanna clay loam, 2 to 4 percent slopes -----	2,680	.2	WF	Wet land -----	38,800	2.3
Tf	Tanna clay loam, 4 to 8 percent slopes -----	9,250	.5	WG	Whitore stony loam, hilly -----	3,050	.2
Tg	Tanna-Absher clay loams -----	520	(¹)	WH	Whitore complex, rolling -----	6,910	.4
Th	Tanna-Wayden clay loams, rolling -----	4,680	.3	WL	Whitore complex, hilly -----	2,970	.2
TK	Tenex cobbly loam, hilly -----	3,700	.2	Wk	Williams cobbly loam, gently sloping -----	6,130	.4
TL	Terrace escarpments and Fairfield soils -----	52,350	3.1	Wm	Williams cobbly loam, undulating -----	51,800	2.9
Tm	Thebo clay, undulating -----	1,850	.1	WN	Williams complex, hilly -----	50,830	2.9
Tn	Timberg clay loam, undulating --	2,310	.1	WO	Williams complex, steep -----	9,740	.6
TN	Tinsley soils -----	3,320	.2	Wr	Williams-Zahl complex, undulating -----	3,000	.2
To	Turner loam, 0 to 4 percent slopes -----	1,320	.1	WS	Williams-Zahl complex, hilly -----	16,990	1.0
Tr	Turner cobbly loam, 0 to 4 percent slopes -----	4,660	.3	WT	Williams-Zahl complex, steep --	3,310	.2
Ts	Turner-Beaverton loams, 0 to 4 percent slopes -----	1,340	.1	Ye	Yetull fine sand -----	760	(¹)
Ua	Utica very gravelly sandy loam --	4,390	.3	ZA	Zahl complex, hilly -----	4,960	.3
Va	Vanda clay -----	4,930	.3		Gravel pits -----	670	(¹)
Wa	Wayden clay loam, undulating ---	7,320	.4		Intermittent lakes -----	1,990	.1
Wb	Wayden clay loam, hilly -----	21,920	1.3		Lakes and streams -----	18,950	1.1
					Total -----	1,709,408	100.0

¹ Less than 0.05 percent.

Absher Series

The Absher series consists of deep, well-drained soils on terraces, uplands, and fans. These soils formed in alluvium. Slopes are 0 to 6 percent. Elevation ranges from 3,600 to 4,500 feet. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, green needlegrass, and some forbs and shrubs. The mean annual precipitation is 12 to 14 inches. The mean annual air temperature is 39° to 41° F, and the growing season is 90 to 110 days.

In a representative profile the surface layer is about 2 inches thick; the upper 1 inch is light-gray loam, and the lower part is dark grayish-brown clay loam. The subsoil is grayish-brown clay loam 12 inches thick. The substratum is a calcareous, light brownish-gray clay loam.

Permeability is very slow, and the available water capacity is moderate or high. Reaction is mildly alkaline to a depth of about 5 inches and moderately alkaline grading to strongly alkaline to a depth of 60 inches. Organic-matter content is low in the surface layer. The surface layer puddles when wet and forms a hard crust when dry.

These soils are used mainly for range.

Representative profile of Absher clay loam in an area of Absher complex under native grass, 400 feet south and 400 feet east of the center of sec. 27, T. 33 N., R. 6 W.:

A21—0 to 1 inch, light-gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; weak, fine, platy structure; slightly hard, very friable, nonsticky and slightly plastic; mildly alkaline; abrupt, discontinuous boundary.

A22—1 to 2 inches, dark grayish-brown (2.5YR 4/2) clay

loam, olive brown (2.5Y 4/4) moist; moderate, fine and very fine, subangular blocky structure; very hard, firm, sticky and plastic; mildly alkaline; abrupt, smooth boundary.

B2t—2 to 5 inches, grayish-brown (2.5Y 5/2) clay loam, olive brown (2.5Y 4/4) moist; moderate, medium, prismatic structure that parts to moderate, medium and fine subangular blocks; very hard, firm, sticky and slightly plastic; common thin clay films; slight effervescence; mildly alkaline; clear, irregular boundary.

B3cacs—5 to 14 inches, grayish-brown (2.5Y 5/2) clay loam, olive brown (2.5Y 4/4) moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; strong effervescence; many threads of segregated lime and gypsum; moderately alkaline; gradual, wavy boundary.

C1cacs—14 to 30 inches, light brownish-gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, friable, sticky and plastic; strong effervescence; many threads of lime and gypsum; strongly alkaline; clear, wavy boundary.

IIC2—30 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; slight effervescence; strongly alkaline.

The A2 horizon ranges from 2 to 4 inches in thickness. The B2t horizon ranges from clay loam to silty clay in texture. The B3 horizon has 15 to 30 percent, estimated, exchangeable sodium, and the C horizon has 20 to 30 percent. Volume of pebbles ranges from 0 to 10 percent throughout the profile.

Ac—Absher complex (0 to 6 percent slopes). This complex is on terraces and fans. It is about 75 percent Absher clay loam and 10 percent Absher loam.

Included with these soils in mapping, and making up about 15 percent of the complex, are areas of Ethridge, Scobey, and Tanna soils. Most areas of this complex are traversed by one or more intermittent drainage ways. Small subirrigated areas are common.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate or severe.

Soils in this complex are mainly suited to range. Capability unit VI_s-1, dryland; Dense Clay range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Adel Series

The Adel series consists of deep, well-drained soils on alluvial fans, terraces, and swales on uplands. These soils formed in alluvium. Slopes are 0 to 35 percent. Elevation ranges from 4,500 to 6,000 feet. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and Columbia, green, and Richardson needlegrasses. Forbs and aspen are in some places. The mean annual precipitation generally is 15 to 20 inches but is as much as 24 inches, the mean annual air temperature is 37° to 41° F., and the growing season is 60 to 95 days.

In a representative profile the surface layer is very dark gray loam 26 inches thick. The subsoil is dark grayish-brown loam 14 inches thick. The substratum is grayish-brown light clay loam.

Permeability is moderate, and the available water capacity is high. Reaction is slightly acid to a depth of 26 inches and neutral below this depth. Organic-matter content is high in the surface layer.

The soils are mainly used for range. Some areas are used for dryfarmed tame pasture and small grain and as woodland and grazeable woodland.

Representative profile of Adel loam, 0 to 4 percent slopes, in native grass, 150 feet east of center of sec. 11, T. 32 N., R. 13 W.:

- A1—0 to 26 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate, very fine, crumb structure in the upper 7 inches and weak, medium, angular blocky structure in lower 19 inches; slightly hard, very friable, slightly sticky and slightly plastic; slightly acid; clear, smooth boundary.
- B2—26 to 40 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear, wavy boundary.
- C—40 to 68 inches, grayish-brown (10YR 5/2) light gray loam, very dark gray (10YR 3/1) moist; weak, medium, angular blocky structure; hard, firm, sticky and plastic; 5 percent pebbles; neutral.

The A1 horizon ranges from 16 to 40 inches in thickness. The B2 horizon is not present in some places. Below a depth of 40 inches, the reaction ranges from neutral to moderately alkaline. Above a depth of 40 inches, content of rock fragments ranges from 0 to 15 percent, by volume, and below this depth it ranges from 5 to 20 percent.

Ad—Adel loam, 0 to 4 percent slopes. This nearly level and gently sloping soil is on stream terraces and alluvial fans. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of poorly drained soils that support sedges, rushes, and willows and a few small areas of soils that have a few pebbles and cobbles on the surface.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to range, tame pasture, and hay. A small area is used for small grain. Capability unit IV_e-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Ae—Adel loam, 4 to 10 percent slopes. This moderately sloping and strongly sloping soil is on alluvial fans and swales on uplands.

Included with this soil in mapping are a few small areas of soils that have some pebbles and cobbles in the surface layer and small areas of soils that have a dark-colored surface layer 10 to 12 inches thick. Also included are small seeping areas and areas that are frequently flooded.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to range, tame pasture, and hay. To a lesser degree, it is suited to small grain. Capability unit IV_e-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

AB—Adel-Babb complex, hilly (4 to 35 percent slopes). This complex is on hills and in swales on uplands. This complex is about 40 percent Adel soils and about 40 percent Babb soils. Slopes are mostly 8 to 15 percent. Adel soils are in swales, and Babb soils are in plane and convex areas on hills. The Adel soils in this complex have a profile similar to that described as representative of the Adel series. The Babb soils in this complex have a profile similar to that described as representative of the Babb series, but the substratum is light clay loam.

Included with these soils in mapping, and making up about 10 percent of the area, are Hanson soils. This complex is also about 10 percent poorly drained swales and small ponds.

This complex is in a forest-grassland transition zone. Most areas of the Adel and Babb soils have a cover of aspen, the included soils are mainly in rough fescue range, and the poorly drained swales and areas bordering small ponds support sedges and willows.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate. Mean annual precipitation is 20 to 24 inches.

The soils in this complex are suited to woodland and grazeable woodland. Capability unit VI_e-1, dryland; Silty range site, 15- to 19-inch precipitation zone; Adel part in woodland suitability group 4o1, Babb part in woodland suitability group 5o2; windbreak suitability group 4.

AF—Adel-Fifer association, hilly (8 to 35 percent slopes). This association is on uplands. It is about 40 percent Adel loam and 40 percent Fifer loam. Slopes are mainly 8 to 15 percent. The Adel soil is in swales, on foot slopes, and on north-facing side slopes; the Fifer soil is on ridges, steeper side slopes, and south-facing side slopes.

Included with these soils in mapping, and making up about 15 percent of the area, are Leavitt or Michelson soils. Also included, and making up about 5 percent, are Bynum, Pishkun, and Rhoades soils and seeping areas, wet or saline drainageways, and shale or sandstone outcrop.

Runoff is medium or rapid. The hazards of water erosion and soil blowing are slight or moderate.

The soils in this association are mainly suited to range. Capability unit VIe-1, dryland; Adel part in Silty range site, 15- to 19-inch precipitation zone, Fifer part in Shallow range site, 15- to 19-inch precipitation zone; not placed in a woodland suitability group; windbreak suitability group 4.

AL—Adel-Hanson complex, hilly (4 to 35 percent slopes). This complex is on uplands and in swales on uplands. It is about 50 percent Adel loam and 40 percent Hanson stony loam. Slopes are mainly 8 to 15 percent. The Adel soil is in swales, and the Hanson soil is on ridges. The Adel soil has a profile that is similar to the one described as representative of the Adel series but that contains more rock fragments. The Hanson soil has a profile similar to the one described as representative of the Hanson series.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are areas of Babb, Mord, and Whitore soils. Also included are small ponds and poorly drained swales.

Runoff is medium. The hazards of water erosion and soil blowing are slight or moderate. Mean annual precipitation is 20 to 24 inches.

Soils in this complex are mainly suited to range. Capability unit VIe-1, dryland; Silty range site, 20- to 24-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Arnegard Series

The Arnegard series consists of deep, well-drained soils in swales, on low terraces, and on foot slopes. These soils formed in mixed alluvium. Slopes are 0 to 8 percent. Elevation ranges from 4,000 to 4,600 feet. The native vegetation is mainly rough fescue and Idaho fescue. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is dark grayish-brown loam 11 inches thick. The subsoil is grayish-brown, light brownish-gray, and pale-brown loam 25 inches thick. The substratum is light brownish-gray and brown clay loam.

Permeability is moderate, and the available water capacity is high. Reaction is neutral to a depth of 30 inches and mildly alkaline or moderately alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for dryfarmed small grain, tame pasture, and range.

Representative profile of Arnegard loam, 0 to 2 percent slopes, in native grass, 2,000 feet west and 200 feet south of the center of sec. 21, T. 35 N., R. 9 W.:

A11—0 to 1 inch, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky and moderate, very fine, granular structure; slightly hard, very friable, non-sticky and nonplastic; neutral; abrupt, smooth boundary.

A12—1 to 11 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; neutral; abrupt, smooth boundary.

B1—11 to 19 inches, grayish-brown (10YR 5/2) loam, very dark grayish-brown (10YR 3/2) moist; weak, medium, prismatic structure that parts to weak,

angular blocks; slightly hard, very friable, non-sticky and nonplastic; neutral; gradual, smooth boundary.

B21—19 to 30 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure that parts to moderate, medium and fine, angular blocks; hard, friable, slightly sticky and slightly plastic; neutral; gradual, smooth boundary.

B22—30 to 36 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure; hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear, smooth boundary.

C1ca—36 to 45 inches, light brownish-gray (10YR 6/2) light clay loam, dark grayish brown (10YR 4/2) moist; weak, fine and very fine, angular blocky structure; hard, friable, slightly sticky and slightly plastic; moderately alkaline; slight effervescence; gradual, smooth boundary.

C2ca—45 to 60 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; massive; very hard, friable, sticky and plastic; slight effervescence; few threads of segregated lime; moderately alkaline.

Segregated lime in the Cca horizon ranges from a few faint threads to many white spots and threads.

Ag—Arnegard loam, 0 to 2 percent slopes. This nearly level soil is in swales and on low terraces. It has the profile described as representative of the series.

Included with this soil in mapping are some areas that have a surface layer of silt loam. Also included are a few small areas of light-colored, slowly permeable soils that have a claypan.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IIIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Ah—Arnegard loam, 2 to 8 percent slopes. This soil is on foot slopes. It has a profile similar to that described as representative of the series, but the surface layer is thinner and the depth to lime is about 30 inches.

Included with this soil in mapping are small areas of Reeder silt loam.

Runoff is medium. The hazards of soil blowing and water erosion are moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IIIe-2, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Attewan Series

The Attewan series consists of deep, well-drained soils on fans and on stream and lake terraces. These soils formed in glacial sediments of mixed mineralogy. They are underlain by sand at a depth of 24 to 40 inches. Slopes are 0 to 8 percent. Elevation ranges from 3,600 to 4,300 feet. The native vegetation is mainly prairie sandreed, needleandthread, rough fescue, and bluebunch wheatgrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown sandy loam and sandy clay loam 5

inches thick. The subsoil is grayish-brown sandy clay loam 10 inches thick. The substratum is grayish-brown sandy clay loam 13 inches thick over red, black, and brown sand.

Permeability is moderate to a depth of 28 inches and rapid or very rapid below that depth. Available water capacity is low or moderate. Reaction is neutral in the surface layer, mildly alkaline to a depth of 28 inches, and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are mainly used for dryfarmed small grain, tame pasture, and range.

Representative profile of Attewan sandy loam, 0 to 4 percent slopes, in native grass, 1,350 feet west and 20 feet north of southeast corner of sec. 28, T. 35 N., R. 6 W.:

- A11—0 to 3 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, crumb structure; soft, very friable, nonsticky and nonplastic; neutral; clear, smooth boundary.
- A12—3 to 5 inches, grayish-brown (10YR 5/2) light sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure; hard, friable, slightly sticky and slightly plastic; neutral; clear, wavy boundary.
- B2t—5 to 15 inches, grayish-brown (10YR 5/2) sandy clay loam, dark brown (10YR 3/3) moist; strong, medium, prismatic structure that parts to moderate, fine angular blocks; hard, friable, sticky and plastic; thin continuous clay film on ped; mildly alkaline; gradual, wavy boundary.
- C1ca—15 to 28 inches, grayish-brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure that parts to medium and fine granules; slightly hard, friable, sticky and plastic; slight effervescence; mildly alkaline; gradual, wavy boundary.
- IIC2—28 to 60 inches, red, black, and brown sand; single grain; loose, nonsticky and nonplastic; 10 percent pebbles; slight effervescence; moderately alkaline.

The noncalcareous solum ranges from 12 to 18 inches in thickness. The A horizon is sandy clay loam, loam, or sandy loam. Depth to the loose sandy material ranges from 24 to 40 inches. To a depth of 28 inches, content of pebbles ranges from 0 to 5 percent, by volume, and below this depth it ranges from 5 to 15 percent.

Ak—Attewan sandy loam, 0 to 4 percent slopes. This nearly level and gently sloping soil is on fans and terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have a surface layer of silt loam, loam, or clay loam. Also included are a few small areas of soils that are severely eroded and have lost all or nearly all of the surface layer.

Runoff is slow. The hazard of erosion is slight, and the hazard of soil blowing is moderate. Available water capacity is low.

This soil is suited to small grain, tame pasture, and range. Capability unit IIIe-4, dryland; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Am—Attewan sandy loam, 4 to 8 percent slopes. This moderately sloping soil is on fans, dissected terraces, and edges of terraces.

Included with this soil in mapping are a few areas of soils that have a surface layer of silt loam, loam,

or clay loam. Also included are a few small areas of Tally and Yetull soils and a few small blowout areas and sand dunes.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Available water capacity is low.

The soil is suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

An—Attewan loam, 0 to 4 percent slopes. This nearly level and gently sloping soil is on fans and terraces. It has a profile similar to that described as representative of the series, but the surface layer is loam and the subsoil contains less sand.

Included with this soil in mapping are small areas of soils that have a surface layer of sandy loam or silt loam. Also included are small areas of Brockway, Ethridge, and Linnet soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Available water capacity is low or moderate.

This soil is suited to small grain, tame pasture, and to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Ao—Attewan loam, 4 to 8 percent slopes. This moderately sloping soil is on fans and terraces. It has a profile similar to that described as representative of the series, but the surface layer is loam and the subsoil contains less sand.

Included with this soil in mapping are a few small areas of soils that have a surface layer of sandy loam, silt loam, or silty clay loam. Also included are a few small areas of Brockway, Ethridge, and Linnet soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Available water capacity is low or moderate.

This soil is suited to small grain, tame pasture, and to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Babb Series

The Babb series consists of deep, well-drained soils on uplands. These soils formed in calcareous glacial till of mixed origin. Slopes are 2 to 35 percent. Elevation ranges from 4,500 to 6,000 feet. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and forbs. Aspen are in some places. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is black cobbly loam 7 inches thick. The subsoil is dark grayish-brown and grayish-brown gravelly loam 14 inches thick. The substratum is white gravelly loam.

Permeability and available water capacity are moderate. Reaction is neutral to a depth of 21 inches and mildly alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for range. Some areas are used for tame pasture, woodland, and grazeable woodland.

Representative profile of Babb cobbly loam in an area of Babb-Hanson complex, hilly, in native grass, 400 feet east and 300 feet south of northwest corner of sec. 14, T. 35 N., R. 14 W.:

- A1—0 to 7 inches, black (10YR 2/1) cobbly loam, black (10YR 2/1) moist; moderate, fine, crumb structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine and medium interstitial pores; 30 percent cobbles; neutral; clear, irregular boundary.
- B21—7 to 15 inches, dark grayish-brown (10YR 4/2) gravelly loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium interstitial pores; few tubular pores; common fine roots; 25 percent pebbles; neutral; clear, smooth boundary.
- B22—15 to 21 inches, grayish-brown (10YR 5/2) gravelly loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium interstitial pores; few, fine, tubular pores; common fine roots; 25 percent pebbles; neutral; abrupt, wavy boundary.
- Cca—21 to 60 inches, white (10YR 8/2) gravelly loam, light brownish gray (10YR 6/2) moist; massive; very hard, friable, slightly sticky and slightly plastic; few, fine, tubular pores; few fine roots, concentrations of roots in vertical cracks; 25 percent pebbles; strong effervescence; accumulated lime disseminated, coarse fragments coated with lime; mildly alkaline.

The solum ranges from 16 to 30 inches in thickness. Content of rock fragments ranges from 10 to 30 percent, by volume, throughout the profile.

Ba—Babb cobbly loam, undulating (2 to 4 percent slopes). This soil is on uplands.

Included with this soil in mapping are a few small areas of deep, black, well-drained soils in swales and closed basins. Also included are small areas of poorly drained soils and small areas of shallow, stony soils on narrow ridges.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to range, tame hay, and pasture. Capability unit IVE-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Bb—Babb cobbly loam, gently rolling (2 to 8 percent slopes). This soil is on uplands.

Included with this soil in mapping are a few small areas of poorly drained soils. Also included are small areas of shallow, stony soils on some of the narrow ridges, and small areas of Adel soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to tame hay, to pasture, and to range. Capability unit IVE-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

BC—Babb cobbly loam, hilly (10 to 20 percent slopes). This soil is on uplands. It has a profile similar to that described as representative of the series, but in a few areas shale or sandstone bedrock is below a depth of 40 inches.

Included with this soil in mapping are a few small

areas of shallow, stony soils and poorly drained soils. Also included are small areas of Adel soils on foot slopes and in swales.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

This soil is suited to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

BF—Babb-Hanson complex, hilly (4 to 35 percent slopes). This complex is on uplands. This complex is about 50 percent Babb soils and 40 percent Hanson soils. Slopes are mostly 8 to 15 percent. Babb soils are on foot slopes and on the sides of ridges and hills; Hanson soils are on ridges and hilltops. A Babb and a Hanson soil in this complex have the profiles described as representative of their respective series.

Included with these soils in mapping, and making up about 10 percent of the mapped areas, are well-drained Adel soils in swales and basins. Also included are a few small lakes and poorly drained swales.

Runoff is medium. The hazards of water erosion and soil blowing are slight or moderate.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Babb Variant

The Babb variant consists of deep, well-drained soils on uplands. These soils formed in glacial till. Elevation ranges from 4,300 to 4,600 feet. Slopes are 2 to 35 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, forbs, and woody plants. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 80 to 95 days.

In a representative profile the surface layer is very dark brown and very dark grayish-brown sandy loam 6 inches thick. The subsoil is grayish-brown heavy sandy loam in the upper 8 inches and light brownish-gray sandy loam in the lower 8 inches. The substratum is light-gray sandy loam in the upper 12 inches and light brownish-gray loamy sand to a depth of 60 inches.

Permeability is moderate to a depth of about 34 inches and moderately rapid below that depth. Available water capacity is moderate. Reaction is neutral to a depth of 14 inches and moderately alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for range. Some areas are used for tame pasture.

Representative profile of Babb sandy loam, sandy subsoil variant, undulating, in native grass, one-fourth mile north of the center of sec. 16, T. 37 N., R. 12 W.:

A11—0 to 1½ inches, very dark brown (10YR 2/2) sandy loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, slightly sticky and plastic; neutral; abrupt, smooth boundary.

A12—1½ to 6 inches, very dark grayish-brown (10YR 3/2) sandy loam, very dark brown (10YR 2/2) moist; weak, medium, angular blocky and very fine, crumb structure; soft, very friable, slightly sticky and slightly plastic; neutral; clear, irregular boundary.

B2—6 to 14 inches, grayish-brown (10YR 5/2) heavy sandy loam, dark grayish brown (10YR 4/2) moist; weak, moderate, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear, irregular boundary.

B3ca—14 to 22 inches, light brownish-gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; light gray (10YR 7/2) lime masses; moderately alkaline; gradual, smooth boundary.

C1ca—22 to 34 inches, light-gray (10YR 7/2) sandy loam, pale brown (10YR 6/3) moist; weak, coarse, angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 5 percent pebbles; strong effervescence; lime coats on pebbles; moderately alkaline; gradual, smooth boundary.

C2—34 to 60 inches, light brownish gray (2.5Y 6/2) loamy sand, light olive brown (2.5Y 5/4) moist; single grained; loose, nonsticky and nonplastic; 10 percent pebbles; strong effervescence; white (2.5Y 8/2) masses of lime; moderately alkaline.

The B horizon ranges from sandy loam to sandy clay loam. To a depth of 34 inches, content of rock fragments ranges from 0 to 10 percent, by volume; below this depth, it ranges from 5 to 15 percent.

Bd—Babb sandy loam, sandy subsoil variant, undulating (2 to 6 percent slopes). This soil is on uplands. Slopes are mostly 2 to 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Adel, Leavitt, and Babb soils. Also included are small areas of poorly drained soils, small lakes, and steep soils on short slopes.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to range and tame pasture. Capability unit IVe-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

BG—Babb sandy loam, sandy subsoil variant, hilly (4 to 35 percent slopes). This soil is on uplands. Slopes are mostly 8 to 15 percent.

Included with this soil in mapping are a few small areas of Leavitt, Babb, and Adel soils. Also included are small areas of seeps, small lakes, and very steep soils.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate to severe.

This soil is suited to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Badland

BL—Badland (15 to 70 percent slopes). This land type is mainly along Two Medicine and Milk Rivers. It consists of steep and very steep land and many drainageways that dissect shale or interbedded shale-sandstone formations. Areas generally range from 100 acres to 600 acres in size. Small areas are included in areas of other soils.

Runoff is very rapid. Much of the acreage of Badland is barren or nearly barren, and some is saline and heavily silted. Twenty-five to 50 percent of the local areas is in vegetation, which generally is in the

narrow drainageways, small pockets, shelves, and remnants of older, eroded landforms. Vegetation in the drainageways is sometimes favored by runoff from the surrounding slopes.

Livestock travel generally is restricted to the drainageways, but livestock do find their way from one drainageway to the next. Capability unit VIIIs-1, dryland; not assigned to a range site or a woodland suitability group; windbreak suitability group 4.

Bear Lake Series

The Bear Lake series consists of deep, poorly drained soils on stream terraces and in swales and basins on uplands. These soils formed in alluvium. Elevation ranges from 4,000 to 5,000 feet. Slopes are 0 to 4 percent. The native vegetation is mainly basin wildrye, prairie cordgrass, northern reedgrass, and tall and low sedges. The mean annual precipitation is 13 to 18 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 70 to 100 days.

In a representative profile the surface layer is dark gray and gray silty clay loam 17 inches thick. The underlying material is mostly light gray; the upper 17 inches is silty clay loam and silty clay, the middle 5 inches is very fine sandy loam volcanic ash, and the lower part is clay.

Permeability is slow. Available water capacity is high. A seasonal high water table is at a depth of less than 2 feet. Reaction is mostly moderately alkaline. Organic-matter content is high in the surface layer.

These soils are used mainly for native range.

Representative profile of Bear Lake silty clay loam, in native grass, 1,180 feet west and 200 feet north of the southeast corner of sec. 27, T. 33 N., R. 10 W.:

A11cag—0 to 6 inches, dark-gray (N 4/) silty clay loam, very dark gray (N 3/) moist; weak, thick, platy structure that parts to moderate, fine and very fine granules; slightly hard, friable, sticky and plastic; strong effervescence; moderately alkaline; clear, wavy boundary.

A12cag—6 to 17 inches, gray (N 5/) silty clay loam, dark gray (5Y 4/1) moist; moderate, very fine, granular structure; slightly hard, very friable, sticky and plastic; strong effervescence; moderately alkaline; gradual, irregular boundary.

C1cag—17 to 28 inches, light-gray (5Y 7/1) silty clay loam, gray (5Y 5/1) moist; moderate, fine, granular structure; slightly hard, friable, sticky and plastic; strong effervescence; many, fine and coarse, white (N 8/) lime masses, light gray (5Y 7/1) moist; moderately alkaline; gradual, smooth boundary.

C2cag—28 to 34 inches, white (5Y 8/1) and gray (5Y 6/1) silty clay, gray (5Y 5/1) and olive gray (5Y 5/2) moist; few brown and light brown mottles; moderate, medium and thin, platy structure; slightly hard, friable, sticky and plastic; violent effervescence; moderately alkaline; abrupt, irregular and broken boundary.

IIC3—34 to 39 inches, light-gray (10YR 7/2) very fine sandy loam volcanic ash, pale brown (10YR 6/3) and grayish brown (10YR 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; slight effervescence; moderately alkaline; abrupt, wavy boundary.

IIIC4g—39 to 45 inches, light-gray and gray (N 7/ and N 6/) light clay, gray (N 5/) moist; common, dark grayish-brown and yellowish-brown mottles (10YR 4/2 and 5/4) moist; massive; very hard, firm, sticky and plastic; strong effervescence; moderately alkaline; gradual, smooth boundary.

IVC5g—45 to 66 inches, light-gray and gray (5Y 7/1 and

N 5/) dense clay, dark gray and olive gray (N 4/ and 5Y 5/2) moist; many, medium and coarse, light olive-brown and olive-yellow (2.5Y 5/4 and 5/6) mottles; extremely hard, very firm, very sticky and very plastic; slight effervescence; horizon grades with depth to somewhat stratified clay containing saturated sand lenses.

In some places the mineral A horizon is covered by a 1- or 2-inch-thick mat of organic fibrous roots. The upper 3 to 5 inches of the solum in some places is leached. The C1 horizon is silty clay loam or clay loam. The layer of volcanic ash is absent in some places.

In this survey area, soils mapped as the Bear Lake series have soil temperatures in summer a few degrees cooler than is typical for the series.

Be—Bear Lake silty clay loam (0 to 4 percent slopes). This nearly level and gently sloping soil is on stream terraces.

Included with this soil in mapping are a few small areas of Gallatin, Novary, and Gapo soils. Also included are a few small areas of saline soils and soils that have a slowly permeable claypan.

Runoff is slow. The hazards of water erosion and soil blowing are slight.

This soil is suited to native range, tame pasture, and hay. Capability unit Vw-1, dryland; Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3W.

Bearmouth Series

The Bearmouth series consists of deep, well-drained soils on stream terraces and outwash fans. These soils formed in mixed alluvium and are underlain by sand and gravel at a depth of 10 to 20 inches. Elevation ranges from 4,400 to 5,000 feet. Slopes are 0 to 4 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Parry danthonia, and sun sedge. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is dark-brown gravelly loam 5 inches thick. The subsoil is dark yellowish-brown very gravelly loam 8 inches thick. The substratum is grayish-brown very gravelly sand.

Permeability is rapid to a depth of 13 inches and very rapid below that depth. Available water capacity is very low. Reaction is neutral to a depth of 13 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for range.

Representative profile of Bearmouth gravelly loam, 0 to 4 percent slopes, in native grass, 2,300 feet west and 1,000 feet north of southeast corner of sec. 7, T. 36 N., R. 12 W.:

A1—0 to 5 inches, dark-brown (10YR 3/3) gravelly loam, very dark brown (10YR 2/2) moist; weak, fine, crumb structure; soft, very friable, nonsticky and nonplastic; 25 percent pebbles, 10 percent cobbles; neutral; clear, wavy boundary.

B2—5 to 13 inches, dark yellowish-brown (10YR 3/4) very gravelly loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; loose, very friable, non-sticky and slightly plastic; 50 percent pebbles, 10 percent cobbles; neutral; gradual, wavy boundary.

IICca—13 to 60 inches, grayish-brown (2.5Y 3/2) very gravelly sand, very dark grayish brown (2.5Y 3/2) moist; single grained; loose; lime coatings on many

sand grains and pebbles; 50 percent pebbles, 30 percent cobbles; moderately alkaline.

To a depth of 13 inches, content of rock fragments ranges from 25 to 60 percent, by volume, and below this depth it ranges from 80 to 90 percent.

Bg—Bearmouth gravelly loam, 0 to 4 percent slopes.

This nearly level or gently sloping soil is on terraces and outwash fans. In most areas of this soil the surface is very uneven as a result of the braided pattern of depositing streams.

Included with this soil in mapping are a few small areas of Tinsley soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

This soil is suited to range. Capability unit VIs-1, dryland; Shallow to Gravel range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Beaverton Series

The Beaverton series consists of deep, well-drained soils on stream terraces and fans. These soils formed in mixed alluvium and are underlain by sand and gravel at a depth of 10 to 20 inches. Elevation ranges from 4,000 to 5,000 feet. Slopes are 0 to 4 percent. The native vegetation is mainly bluebunch, western, and thick-spike wheatgrasses and needleandthread. The mean annual precipitation is 12 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 80 to 105 days.

In a representative profile the surface layer is grayish-brown gravelly loam 2 inches thick. The subsoil is dark grayish-brown gravelly clay loam and very gravelly clay loam 12 inches thick. The substratum is grayish-brown very gravelly loamy sand and very gravelly sand.

Permeability is moderate to a depth of 14 inches and rapid below that depth. Available water capacity is very low. Reaction is neutral to a depth of 14 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for range.

Representative profile of Beaverton gravelly loam, 0 to 4 percent slopes, in native grass, 1,000 feet north and 200 feet east of the southwest corner of sec. 31, T. 33 N., R. 10 W.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate, fine, crumb structure; soft, very friable, slightly sticky and nonplastic; many, very fine and medium roots; 20 percent pebbles; neutral; clear, irregular boundary.

B21t—2 to 9 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, angular blocky structure that parts to strong, fine and very fine, angular blocks; hard, friable, sticky and plastic; common, very fine and medium roots; many, fine and very fine, tubular pores; many thin clay films on peds one-half to one color value darker than the inside of the peds; 25 percent pebbles; neutral; clear, smooth boundary.

B22t—9 to 14 inches, dark grayish-brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, angular blocky structure; hard, friable, slightly sticky and slightly plastic; common, very fine roots; many, fine, tubular

- pores; common thin clay films on peds; 60 percent pebbles; neutral; clear, irregular boundary.
- IIC1ca—14 to 20 inches, grayish-brown (2.5Y 5/2) very gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose, very friable, non-sticky and nonplastic; many, fine, branched roots; 65 percent pebbles; lime coatings on undersides of pebbles; moderately alkaline; gradual, irregular boundary.
- IIC2—20 to 60 inches, very gravelly sand; single grained; loose; very few roots; lime coatings on undersides of pebbles in upper part.

To a depth of 14 inches, content of rock fragments ranges from 10 to 65 percent, and below this depth it ranges from 60 to 80 percent.

Bh—Beaverton gravelly loam, 0 to 4 percent slopes.

This nearly level to gently sloping soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of poorly drained soils. Also included are small areas of Turner soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to range and tame pasture. Capability unit IVs-1, dryland; Shallow to Gravel range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Bk—Beaverton-Williams complex, undulating (0 to 8 percent slopes). This complex is on fans and uplands. This complex is about 50 percent Beaverton gravelly loam and 45 percent Williams cobbly loam. Slopes are mainly 2 to 4 percent. The Beaverton soil is on fans, and the Williams soil is on uplands. The Beaverton soil has slopes of 0 to 4 percent; the Williams soil has slopes mainly of 2 to 4 percent, but they are as much as 8 percent. The Beaverton soil in this complex has a profile similar to that described as representative of the Beaverton series. The Williams soil has a profile similar to that described as representative of the Williams series, but a few stones are in the surface layer.

Included with these soils in mapping are areas of Turner soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Soils in this complex are suited to range and tame pasture. Capability unit IVs-1, dryland; Beaverton part in Shallow to Gravel range site, 12- to 14-inch precipitation zone, Williams part in Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Beaverton part in windbreak suitability group 3M, Williams part in windbreak suitability group 1.

Boxwell Series

The Boxwell series consists of moderately deep, well-drained soils on uplands. These soils formed in material weathered from shale and sandstone and are underlain at a depth of 24 to 40 inches by weathered shale or sandstone. Elevation ranges from 3,800 to 4,200 feet. Slopes are 2 to 8 percent. The native vegetation is mainly bluebunch wheatgrass, needleand-thread, green needlegrass, and western and thickspike wheatgrass. The mean annual precipitation is 12 to 14

inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown silt loam 5 inches thick. The subsoil is brown and grayish-brown silty clay loam 9 inches thick. The upper part of the substratum is white silt loam 14 inches thick, and the lower part is light gray sandstone that crushes to sandy loam.

Permeability is moderate. Available water capacity is low. Reaction is neutral to a depth of 9 inches, mildly alkaline between depths of 9 and 14 inches, and moderately alkaline below a depth of 14 inches. Organic-matter content is medium in the surface layer.

These soils are mainly used for dryfarmed small grain, pasture, and range.

Representative profile of Boxwell silt loam in an area of Boxwell complex, undulating, in a cultivated field, 200 feet north and 1,600 feet east of the center of sec. 24, T. 36 N., R. 8 W.:

- Ap—0 to 5 inches, grayish-brown (2.5Y 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many, fine, interstitial pores; neutral; abrupt, smooth boundary.
- B2—5 to 9 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure; slightly hard, friable, sticky and plastic; common, fine roots; common, fine, tubular pores; dark grayish-brown (10YR 4/2) coatings, very dark grayish brown (10YR 3/2) moist; neutral; clear, smooth boundary.
- B3—9 to 14 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure; slightly hard, very friable, sticky and plastic; common, fine roots; common, fine, tubular pores; slight effervescence; mildly alkaline; clear, wavy boundary.
- C1ca—14 to 28 inches, white (5Y 8/2) silt loam, light gray (5Y 7/2) moist; weak, coarse, prismatic structure that parts to weak, thin plates; slightly hard, very friable, slightly sticky and slightly plastic; common, fine roots; common, fine pores; strong effervescence; many thin films and soft nodules of segregated lime; moderately alkaline; gradual, smooth boundary.
- IIC2—28 to 60 inches, light-gray (5Y 7/2) sandstone that crushes to sandy loam, light olive gray (5Y 6/2) moist; strong effervescence.

Depth to the calcareous material ranges from 8 to 16 inches.

Bo—Boxwell complex, undulating (2 to 8 percent slopes). This complex is on uplands. It is about 65 percent Boxwell silt loam and 30 percent Cabba loam. Slopes are mainly 2 to 4 percent. The Boxwell soil is in swales, on foot slopes, and on north-facing side slopes; and the Cabba soil is on ridges and south-facing side slopes.

Included with these soils in mapping, and making up about 5 percent of the mapped areas, are areas of Tanna and Wayden soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are well suited to small grain, pasture, and range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; these soils are not assigned to a woodland suitability group; windbreak suitability group 2M.

Bridger Series

The Bridger series consists of deep, well-drained soils on uplands. These soils formed in glacial till. Elevation ranges from 4,500 to 6,000 feet. Slopes are 8 to 40 percent. The native vegetation is mainly rough fescue, Richardson needlegrass, mountain brome, and Columbia needlegrass. The mean annual precipitation is 18 to 24 inches, the mean annual air temperature is 39° to 41°, and the growing season is 60 to 90 days.

In a representative profile the surface layer is dark-brown stony loam 5 inches thick. The subsoil is brown and dark grayish-brown stony clay loam 29 inches thick. The substratum is light brownish-gray stony clay loam.

Permeability is moderate. Available water capacity is moderate. Reaction is neutral to a depth of 22 inches and mildly alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for range.

Representative profile of Bridger stony loam from an area of Bridger-Rock land association, very steep, in native grass, 1,200 feet east, 200 feet north of the center of sec. 3, T. 30 N., R. 12 W.:

- A1—0 to 5 inches, dark-brown (7.5YR 3/2) stony loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, non-sticky and nonplastic; 20 percent by volume flat, subangular stones, cobbles, and pebbles; neutral; clear, irregular boundary.
- B1—5 to 11 inches, brown (7.5YR 5/2) stony clay loam, dark brown (7.5YR 3/2) moist; moderate, very fine, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 30 percent stones, cobbles, and pebbles; neutral; clear, smooth boundary.
- B21t—11 to 22 inches, brown (7.5YR 5/4) stony heavy clay loam, dark brown (7.5YR 3/2) moist; strong, very fine, angular blocky structure; very hard, friable, sticky and plastic; common, thick clay films on peds; 20 percent stones, cobbles, and pebbles; neutral; clear, smooth boundary.
- B22t—22 to 34 inches, dark grayish-brown (10YR 4/2) stony clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, angular blocky structure; very hard, firm, sticky and plastic; common, moderately thick clay films on peds; 30 percent stones, cobbles, and pebbles; mildly alkaline; clear, wavy boundary.
- Cca—34 to 60 inches, light brownish-gray (2.5Y 6/2) stony clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; 50 percent coarse fragments; streaks and spots of white segregated lime; mildly alkaline.

The A horizon is very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), or dark brown (7.5YR 3/2). Depth to the calcareous material ranges from 18 to 36 inches. To a depth of 34 inches, content of rock fragments ranges from 20 to 30 percent, and below this depth it ranges from 35 to 70 percent.

BM—Bridger-Mord association, hilly (4 to 40 percent slopes). This association is on uplands. About 60 percent of this association is Bridger stony loam, and 30 percent is Mord loam. Slopes are mainly 8 to 15 percent. The Bridger soil generally is in grassy, convex south-, west-, and east-facing areas. The Mord soil is in concave, generally north-facing areas and has an overstory of aspen and an understory of grass. The Bridger soil has slopes of 8 to 40 percent, and the Mord soil has slopes of 4 to 8 percent.

Included with these soils in mapping, and making up

10 percent of the area, are areas of rocky ridgetops and areas of poorly drained soils in swales and closed basins.

Runoff is medium or rapid. The hazard of water erosion is moderate on the Bridger soil and slight on the Mord soil. The hazard of soil blowing is slight or moderate on both soils.

The Bridger soil in this association is suited mainly to range, and the Mord soil is suited mainly to grazable woodland. Capability unit VIe-1, dryland; Bridger part in Silty range site, 20- to 24-inch precipitation zone, Mord part not assigned to a range site; Bridger part not assigned to a woodland suitability group, Mord part in woodland suitability group 4o1; windbreak suitability group 4.

BN—Bridger-Rock land association, very steep (15 to 60 percent slopes). This association is on uplands. It is about 65 percent Bridger stony loam and 30 percent Rock land. Slopes are mainly 35 to 60 percent. The Bridger soil is on side slopes, and Rock land is mainly on ridgetops. The Bridger soil has slopes mainly of 15 to 35 percent, and Rock land has slopes mainly of 35 to 60 percent. The Bridger soil has the profile described as representative of the Bridger series. Rock land consists of outcrops of hard, brown sandstone that is nearly barren of vegetation and is surrounded by shallow and very shallow soils.

Included in mapping are Mord soils on north-facing sides of drainageways.

Runoff is medium or rapid. The hazard of water erosion is moderate or severe, and the hazard of soil blowing is slight or moderate.

This association is suited mainly to range. Aspen occur in some of the drainageways and on north-facing areas. Bridger part in capability unit VIe-1, dryland, Rock land part in capability unit VIIIs-1, dryland; Bridger part in Silty range site, 20- to 40-inch precipitation zone, Rock land part not assigned to a range site; not assigned to a woodland suitability group; Bridger part in windbreak suitability group 4, Rock land part not assigned to a windbreak suitability group.

Brockway Series

The Brockway series consists of deep, well-drained soils on lake terraces on uplands. These soils formed in calcareous lake sediment. Elevation ranges from 3,600 to 4,200 feet. Slopes are 0 to 8 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, western and thickspike wheatgrasses, and green needlegrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown silt loam 6 inches thick. The upper 5 inches of the underlying material is light brownish-gray silt loam, the next 17 inches is light-gray silty clay loam, the next 11 inches is light-gray very fine sandy loam, and the lower part is stratified light-gray very fine sandy loam and light brownish-gray silty clay.

Permeability is moderately slow. Available water capacity is high. Reaction is moderately alkaline. Organic-matter content is low in the surface layer.

These soils are used for dryfarmed and irrigated small grain, tame pasture, irrigated alfalfa hay, and range.

Representative profile of Brockway silt loam, 0 to 2 percent slopes, 1,320 feet west and 200 feet south of northeast corner of sec. 17, T. 34 N., R. 6 W.:

- Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline; abrupt, smooth boundary.
- C1—6 to 11 inches, light brownish-gray (2.5Y 6/2) silt loam, light olive brown (2.5Y 5/4) moist; weak, medium, prismatic structure that parts to weak, friable, slightly sticky and slightly plastic; many, fine roots; many, fine, tubular pores; strong effervescence; moderately alkaline; abrupt, smooth boundary.
- C2ca—11 to 18 inches, light-gray (2.5Y 7/2) silty clay loam, light olive brown (2.5Y 5/4) moist; weak, medium, prismatic structure that parts to weak, thin plates; very fine stratification of silty clay loam and silt loam; hard, friable, sticky and plastic; many, fine roots; many, fine, tubular pores; many, segregated, white lime spots on dark-colored plates of soil; strong effervescence; moderately alkaline; abrupt, smooth boundary.
- C3ca—18 to 28 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; moderate, very thin lamellae of dark grayish-brown (2.5Y 4/2), moist, silty clay loam and silty clay, and light olive-brown (2.5Y 5/4), moist, silt; hard, friable, sticky and plastic; common, fine roots; common, fine, tubular pores; many, segregated, white lime spots on dark-colored silty clay plates; very strong effervescence; moderately alkaline; abrupt, smooth boundary.
- C4—28 to 39 inches, light-gray (2.5Y 7/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; common, fine roots; common, fine, tubular pores; strong effervescence; moderately alkaline; abrupt, smooth boundary.
- C5cs—39 to 60 inches, light brownish-gray (2.5Y 6/2), silty clay lamellae in light-gray (2.5Y 7/2), very fine sandy loam matrix (average texture is silty clay loam), grayish brown (2.5Y 5/2) and light yellowish brown (2.5Y 6/4) moist; weak, thin and very thin varves, material at 39 to 41 inches, 43 to 44 inches, 47 to 48 inches, and 58 to 60 inches is mainly clay and silty clay varves; slightly hard, friable, sticky and plastic; strong effervescence; many fine gypsum crystals; moderately alkaline.

The A horizon is silt loam or silty clay loam, and some uncultivated areas have a layer 2 to 4 inches thick that is leached of lime. The C horizon is stratified and ranges from very fine sandy loam to silty clay.

Br—Brockway silt loam, 0 to 2 percent slopes. This nearly level soil is on lake terraces on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of concave Ethridge soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. Where irrigated, it is also well suited to alfalfa hay. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Bs—Brockway silt loam, 2 to 4 percent slopes. This gently sloping soil is on lake terraces and uplands.

Included with this soil in mapping are a few small areas of Ethridge, Linnet, and Pendroy soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Where irrigated, it is also well suited to alfalfa hay. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Bt—Brockway silt loam, 4 to 8 percent slopes. This moderately sloping soil is on lake terraces on uplands.

Included with this soil in mapping are a few small areas of Ethridge, Linnet, Pendroy, Attawan, Tally, and Yetull soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Where irrigated, it is suited to a lesser degree to alfalfa hay. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Burnette Series

The Burnette series consists of deep, well-drained soils on fans, terraces, uplands, and mountain side slopes. These soils formed in glacial till derived from shale. Elevation ranges from 4,500 to 5,500 feet. Slopes are 2 to 25 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and some forbs and shrubs. The mean annual precipitation is 16 to 24 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is very dark grayish-brown loam and clay loam 15 inches thick. The subsoil is grayish-brown and olive-gray clay 17 inches thick. The substratum is gray and olive-gray clay.

Permeability is moderate to a depth of 15 inches and moderately slow below that depth. Available water capacity is high. Reaction is slightly acid to a depth of 15 inches, neutral between depths of 15 and 26 inches, and mildly alkaline below a depth of 26 inches. Organic-matter content is high in the surface layer.

These soils are used mainly for range. Some areas are used for tame pasture.

Representative profile of Burnette loam, undulating, in native grass, 1,500 feet north of the southwest corner of sec. 2, T. 31 N., R. 12 W.:

- A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) loam, black (10YR 2/1) moist; moderate, very fine, crumb structure; soft, friable, slightly sticky and slightly plastic; 5 percent pebbles; heavy mat of roots in the uppermost 1 inch, many very fine roots below; slightly acid; clear, smooth boundary.
- A12—5 to 15 inches, very dark grayish-brown (10YR 3/2) light clay loam, very dark brown (10YR 2/2) moist; moderate, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; 10 percent pebbles; many, very fine roots; slightly acid; clear, irregular boundary.
- B21t—15 to 26 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure that parts to strong, fine and very fine, subangular blocks; very hard, firm, very sticky and very plastic; common, very

fine roots mainly on dark gray (10YR 4/1) peds; 10 percent pebbles; few, very fine roots; few, fine, tubular pores in peds; neutral; gradual, irregular boundary.

B22t—26 to 32 inches, olive-gray (5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate, coarse, prismatic structure that parts to moderate, fine and medium, subangular blocks; very hard, firm, very sticky and very plastic; 15 percent pebbles; few very fine roots through blocks and many very fine roots on dark-gray (10YR 4/1) prism faces; mildly alkaline; clear, wavy boundary.

C1ca—32 to 50 inches, gray (5Y 5/1) light clay, dark gray (5Y 4/1) moist; weak, coarse, prismatic structure; hard, friable, sticky and plastic; 15 percent pebbles; few, very fine roots; few, fine, tubular pores; strong effervescence; segregated lime threads and spots of light gray (5Y 7/1); mildly alkaline; gradual, wavy boundary.

C2—50 to 66 inches, olive-gray (5Y 5/2) light clay, olive gray (5Y 4/2) moist; massive; hard, friable, sticky and plastic; 10 percent pebbles; few, fine roots; many, gray shale chips; strong effervescence; little segregated lime; mildly alkaline.

The combined thickness of the noncalcareous A and B horizons ranges from 19 to 26 inches. To a depth of 15 inches content of rock fragments ranges from 5 to 30 percent, by volume, and below this depth it ranges from 10 to 20 percent.

BP—Burnette stony loam, hilly (8 to 25 percent slopes). This soil is on long ridges and rounded tops of hills. Slopes are mostly 8 to 15 percent. This soil has a profile similar to that described as representative of the series, but the surface layer contains cobbles and stones.

Included with this soil in mapping are a few small areas of poorly drained soils. Also included are small areas of soils that have a surface layer of clay loam and small areas of Adel, Nettleton, and Doby soils.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

This soil is suited mainly to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Bu—Burnette loam, undulating (2 to 8 percent slopes). This soil is on fans and terraces. Slopes are mainly 2 to 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of somewhat poorly drained soils. Also included are small areas of soils that have a surface layer of silt loam.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited mainly to tame pasture and range. Capability unit IVe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

BW—Burnette-Adel association, rolling (4 to 12 percent slopes). This association is on uplands. This association is about 70 percent Burnette stony loam and 30 percent Adel loam. Slopes are mainly 4 to 8 percent. The Adel soil is in swales and on north-facing side slopes. The Burnette soil has a profile similar to that described as representative of the Burnette series, but the surface layer is stony and the depth to the calcareous material is about 20 inches. The Adel soil has a

profile similar to that described as representative of the Adel series.

Included with these soils in mapping are a few small areas of poorly drained soils and of very stony soils that have slopes of more than 12 percent.

Runoff is medium. The hazards of water erosion and soil blowing are slight or moderate.

The soils in this association are suited mainly to native range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Bynum Series

The Bynum series consists of moderately deep, well-drained soils on uplands. These soils formed in material weathered from shale, siltstone, or sandstone. They are underlain at a depth of 20 to 40 inches by shale. Elevation ranges from 4,400 to 5,500 feet. Slopes are 2 to 8 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and some forbs and shrubs. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 39° to 40° F, and the growing season is 60 to 95 days.

In a representative profile the surface layer is dark gray silt loam 6 inches thick. The subsoil is grayish-brown silty clay loam 8 inches thick. The upper part of the substratum is light-gray silty clay loam 13 inches thick, and the lower part is white silty clay loam 11 inches thick. The underlying bedrock is white and gray siltstone.

Permeability is moderate. Available water capacity is moderate. Reaction is mildly alkaline to a depth of 6 inches, moderately alkaline between depths of 6 and 14 inches, and strongly alkaline below a depth of 14 inches. Organic-matter content is high in the surface layer.

These soils are used mainly for native range. Some areas are used for dryfarmed small grain and tame pasture.

Representative profile of Bynum silt loam, undulating, in native grass, 1,740 feet north and 200 feet east of the center of sec. 10, T. 37 N., R. 10 W.:

A1—0 to 6 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate, very thin, platy structure that parts to moderate, very fine granules; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; clear, irregular boundary, tongues 2 inches wide extend to a depth of 12 inches.

B2t—6 to 9 inches, grayish-brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure that parts to moderate, fine and very fine, angular blocks; hard, firm, sticky and plastic; moderately alkaline; clear, irregular boundary.

B3—9 to 14 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure that parts to moderate, medium, angular blocks; hard, firm, sticky and plastic; slight effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—14 to 27 inches, light-gray (5Y 7/2) silty clay loam, olive gray (5Y 5/2) moist; many, very dark grayish-brown (10YR 3/2) root stains; weak, coarse, prismatic structure that parts to weak, coarse angular blocks and moderate, fine granules; hard, friable, sticky and plastic; strong efferves-

cence; few threads of segregated lime in the upper part and many, white (5Y 8/2) lime mottles in the lower part; strongly alkaline; gradual, wavy boundary.

C2ca—27 to 38 inches, white (5Y 8/1) silty clay loam, light gray (5Y 7/2) moist; many, grayish-brown and dark grayish-brown (2.5Y 5/2 and 4/2) root stains; weak, medium, platy structure; slightly hard, firm, sticky and plastic; strong effervescence; common threads and films of segregated lime; strongly alkaline; gradual, wavy boundary.

C3—38 to 60 inches, white and gray siltstone.

The combined thickness of the A and B horizons and the depth to the Cca horizon range from 11 to 22 inches. The depth to underlying soft shale, siltstone, or sandstone ranges from 20 to 40 inches.

Bv—Bynum silt loam, undulating (2 to 8 percent slopes). This soil is on uplands. Slopes are complex and are mainly 2 to 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have a few cobbles and pebbles in the surface layer, a few small areas of soils that have a surface layer of loam, and small areas of Fifer soils.

Runoff is medium. The hazards of water erosion and soil blowing are slight or moderate.

This soil is suited to native range, cultivated hay, tame pasture, and dryfarmed small grain. Areas above 5,000 feet are not suited generally to small grain, because of the short growing season and wetness during harvest. Capability unit IVe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

By—Bynum-Fifer complex, rolling (4 to 15 percent slopes). This complex is about 70 percent Bynum silt loam that commonly has slopes of 4 to 8 percent and 30 percent Fifer loam that has slopes of 8 to 15 percent. Bynum silt loam is commonly at the base of foot slopes, and Fifer loam is mainly above the Bynum soil. Annual precipitation ranges from 15 to 20 inches.

Included with these soils in mapping are a few small areas of Adel and Pishkun soils.

Runoff is rapid. The hazard of water erosion is moderate or severe, and the hazard of soil blowing is moderate.

These soils are well suited to native range and tame pasture. They are suited to dryfarmed small grain. Capability unit IVe-2, dryland; Bynum part in Silty range site, 15- to 19-inch precipitation zone, Fifer part in Shallow range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; Bynum part in windbreak suitability group 2M, Fifer part in windbreak suitability group 3M.

Cabba Series

The Cabba series consists of shallow, well-drained soils on uplands. These soils formed in material weathered from shale or sandstone. Elevation ranges from 3,600 to 4,600 feet. Slopes are 2 to 50 percent. The native vegetation is mainly bluebunch wheatgrass, western and thickspike wheatgrass, and needleand-thread. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 110 days.

In a representative profile the surface layer is

grayish-brown heavy loam 3 inches thick. The next layer is light brownish-gray loam 10 inches thick. The underlying material is white loam 5 inches thick over soft shale.

Permeability is moderate to a depth of 18 inches and very slow or slow below that depth. Available water capacity is very low or low. Reaction is mildly alkaline to a depth of 13 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed small grain and tame pasture.

Representative profile of Cabba loam, undulating, in native grass, 800 feet north and 300 feet west of the center of sec. 18, T. 33 N., R. 9 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) heavy loam, very dark grayish brown (2.5Y 3/2) moist; weak, very thin, platy structure; slightly hard, soft, slightly sticky and slightly plastic; many, fine roots; slight effervescence; mildly alkaline; abrupt, irregular boundary.

AC—3 to 13 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure; very hard, friable, slightly sticky and slightly plastic; grayish-brown (2.5Y 5/2) coats; strong effervescence; mildly alkaline; gradual, smooth boundary.

C1ca—13 to 18 inches, white (2.5Y 8/2) loam, light brownish gray (2.5Y 6/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many, fine roots; strong effervescence; moderately alkaline; gradual, smooth boundary.

IIC2—18 to 60 inches, soft shale.

The A1 horizon ranges from grayish brown to dark grayish brown and has a hue of 10YR or 2.5Y. The depth to shale or sandstone ranges from 10 to 20 inches.

Ca—Cabba loam, undulating (2 to 8 percent slopes). This soil is on uplands. Slopes are mostly 2 to 4 percent. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of barren shale outcrop, slowly permeable soils that have a claypan, and Boxwell soils.

Runoff is medium or slow. The hazard of water erosion is moderate, and the hazard of soil blowing is severe.

This soil is suited to small grain, tame pasture, and range. Capability unit IVs-2, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Cb—Cabba loam, hilly (8 to 35 percent slopes). This soil is on uplands. Slopes are mainly 8 to 15 percent.

Included with this soil in mapping are a few small areas of barren shale or sandstone outcrop and small areas of Boxwell and Reeder soils.

Runoff is medium or rapid. The hazards of water erosion and soil blowing are moderate or severe.

This soil is well suited to range. Capability unit VIe-1, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Ce—Cabba-Reeder complex, undulating (2 to 8 percent slopes). This complex is on uplands. It is about 45 percent Cabba loam and 45 percent Reeder silt loam. Slopes are mainly 2 to 4 percent. The Cabba soil is on knolls and ridges, and the Reeder soil is on side slopes. The Cabba soil has a profile similar to that described

as representative of the Cabba series, but the surface layer is slightly darker in color and the organic-matter content is higher. The Reeder soil has a profile similar to that described as representative of the Reeder series. Precipitation is 14 to 16 inches, and the growing season is 90 to 100 days.

Included with these soils in mapping are small areas of Arnegard soils and of soils that are similar to Cabba soils but that have shale at a depth of 20 to 40 inches. Also included are small areas of shale or sandstone outcrop, seeped areas, areas of steep soils on short slopes, and areas of soils that have a channery surface layer.

Runoff is slow or medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

Soils in this complex are well suited to range. They are suited to small grain and tame pasture. Capability unit IIIe-2, dryland; Cabba part in Shallow range site, 12- to 14-inch precipitation zone, Reeder part in Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Cabba part in windbreak suitability group 3M, Reeder part in windbreak suitability group 2M.

CK—Cabba-Rock outcrop complex, very steep (15 to 50 percent slopes). This complex is on uplands. It is about 50 percent Cabba loam and 30 percent Rock outcrop. Slopes are mainly 35 to 50 percent.

Included in mapping, and making up about 20 percent of the mapped area, are deep and moderately deep loams and clay loams.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

Soils in this complex are suited to range. Areas of Rock outcrop provide little or no usable forage. Capability unit VIIe-1, dryland; Cabba part in Shallow range site, 12- to 14-inch precipitation zone, Rock outcrop part not assigned to range site or windbreak suitability group; not assigned to a woodland suitability group; Cabba part in windbreak suitability group 4.

Castner Series

The Castner series consists of shallow, well-drained soils on uplands. These soils formed in material weathered from hard sandstone. Elevation ranges from 4,200 to 4,800 feet. Slopes are 2 to 60 percent. The native vegetation is mainly bluebunch wheatgrass, western and thickspike wheatgrass, and needleandthread. The mean annual precipitation is 14 to 18 inches, the mean annual air temperature is 39° to 41° F, and the frost-free season is 80 to 100 days.

In a representative profile the surface layer is grayish-brown and light brownish-gray channery loam 12 inches thick. The underlying material is light gray very channery sandy loam 6 inches thick. Fractured hard sandstone is at a depth of 18 inches.

Permeability is moderately rapid. Available water capacity is very low. Reaction is neutral to a depth of 5 inches, mildly alkaline between depths of 5 and 12 inches, and moderately alkaline below a depth of 12 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for range.

Representative profile of Castner channery loam in an area of Castner-Cabba complex, sloping, in native grass, 1,300 feet north and 800 feet east of center of sec. 29, T. 34 N., R. 9 W.:

- A11—0 to 5 inches, grayish-brown (10YR 5/2) channery loam, dark brown (10YR 3/3) moist; moderate, very fine, crumb structure; soft, very friable, slightly sticky and nonplastic; 15 percent channers; neutral; clear, smooth boundary.
- A12—5 to 12 inches, light brownish-gray (10YR 6/2) channery loam, dark brown (10YR 4/3) moist; weak, coarse, angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 40 percent channers; strong effervescence; mildly alkaline; abrupt, smooth boundary.
- Cca—12 to 18 inches, light-gray (10YR 7/2) very channery sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, slightly sticky and nonplastic; 60 percent channers; strong effervescence; lime coats on coarse fragments; moderately alkaline; clear, smooth boundary.
- R—18 to 24 inches, fractured hard sandstone; a few roots penetrate cracks.

Depth to fractured hard sandstone ranges from 14 to 20 inches. Content of rock fragments ranges from 30 to 60 percent, by volume.

Cn—Castner-Cabba complex, sloping (2 to 8 percent slopes). This complex is on dissected uplands. It is about 40 percent Castner channery loam and about 40 percent Cabba loam. Slopes are mainly 4 to 8 percent. The Castner soil has the profile described as representative of the Castner series. The Cabba soil has a profile similar to that described as representative of the Cabba series.

Included with these soils in mapping, and making up about 20 percent of the mapped areas, are areas mainly of Arnegard and Reeder soils. Also included are a few small areas of Rock outcrop.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate or severe.

Soils in this complex are well suited to range. Capability unit VIe-1, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Co—Castner-Cabba complex, steep (8 to 30 percent slopes). This complex is on dissected uplands. This complex is about 40 percent Castner channery loam and 40 percent Cabba loam. Slopes are mainly 15 to 30 percent.

Included with these soils in mapping, and making up about 20 percent of the mapped areas, are areas mainly of Arnegard and Reeder soils. Also included are a few small areas of Rock outcrop.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

The soils in this complex are well suited to range. Capability unit VIe-1, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

CR—Castner-Rock outcrop complex, very steep (15 to 60 percent slopes). This complex is on side slopes and ridges on uplands. This complex is about 50 percent Castner channery loam and 30 percent sandstone Rock outcrop. Slopes are mainly 35 to 60 percent.

Included in mapping, and making up about 20 percent of the mapped areas, are areas mainly of Arne-

gard, Reeder, and Cabba soils. Also included are some small areas of springs and seeps.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

Soils in this complex are well suited to range. Areas of Rock outcrop provide little or no usable forage. Capability unit VIIe-1, dryland; Castner part in Shallow range site, 12- to 14-inch precipitation zone, Rock outcrop part not assigned to a range site or windbreak suitability group; not assigned to a woodland suitability group; Castner part in windbreak suitability group 4.

Cheadle Series

The Cheadle series consists of shallow, excessively drained soils on uplands. These soils formed in material weathered from hard sandstone. Elevation ranges from 4,500 to 5,800 feet. Slopes are 15 to 60 percent. The native vegetation is mainly bluebunch wheatgrass and rough fescue. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 37° to 41° F, and the frost-free season is 60 to 90 days.

In a representative profile the surface layer is dark gray flaggy sandy loam 7 inches thick. The upper part of the underlying material is pale-brown flaggy sandy loam 5 inches thick, and the lower part is grayish-brown flaggy sandy loam 8 inches thick. Hard, gray sandstone is at a depth of 20 inches.

Permeability is moderate. Available water capacity is very low. Reaction is neutral to a depth of 12 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are mainly used for range.

Representative profile of Cheadle flaggy sandy loam in an area of Fifer-Cheadle-Rock outcrop complex, very steep, in native grass, 300 feet south and 1,300 feet east of the northwest corner of section 36, T. 32 N., R. 12 W.:

A1—0 to 7 inches, dark-gray (10YR 4/1) flaggy sandy loam, very dark gray (10YR 3/1) moist; weak, very fine, crumb structure; soft, very friable, non-sticky and nonplastic; many fine and few coarse roots; 30 percent flagstones; neutral; clear, wavy boundary.

C1—7 to 12 inches, pale-brown (10YR 6/3) flaggy sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, angular blocky structure; soft, very friable, nonsticky and nonplastic; common, fine roots; 40 percent flagstones; neutral; clear, wavy boundary.

C2—12 to 20 inches, grayish-brown (2.5Y 5/2) flaggy light sandy loam, dark grayish brown (2.5Y 4/2) moist; single grained; loose, very friable, nonsticky and nonplastic; many, fine roots matted in places between hard sandstone plates; 60 percent flagstones; slight effervescence; moderately alkaline; clear, wavy boundary.

R—20 to 26 inches, hard, gray sandstone.

Depth to hard bedrock ranges from 12 to 20 inches. Content of rock fragments throughout ranges from 30 to 60 percent, by volume.

This soil is mapped only in a complex with Fifer soils and Rock outcrop.

Crago Series

The Crago series consists of deep, well-drained soils

on fans and terraces. These soils formed in very gravelly and cobbly alluvium derived mainly from limestone. Elevation ranges from 3,600 to 4,400 feet. Slopes are 8 to 50 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, western wheatgrass, and some forbs and shrubs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the frost-free season is 95 to 110 days.

In a representative profile the surface layer is very dark grayish-brown very gravelly loam 3 inches thick. The underlying material is light brownish-gray or light-gray very gravelly loam.

Permeability is slow. Available water capacity is low. Reaction is mildly alkaline to a depth of 3 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are mainly used for range.

Representative profile of Crago very gravelly loam in an area of Crago-Kiev association, steep, in native grass, 1,600 feet north and 400 feet west of the center of sec. 28, T. 31 N., R. 7 W.:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) very gravelly loam, very dark brown (10YR 2/2) moist; weak, fine, crumb structure; slightly hard, very friable, nonsticky and nonplastic; 50 percent pebbles; mildly alkaline; clear, wavy boundary.

C1ca—3 to 9 inches, light brownish-gray (10YR 6/2) very gravelly loam, grayish brown (10YR 5/2) moist; massive to weak, medium, angular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 60 percent pebbles; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2ca—9 to 60 inches, light-gray (10YR 7/2) very gravelly loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 60 percent pebbles; violent effervescence; moderately alkaline.

The A1 horizon is grayish brown or very dark grayish brown. The content of rock fragments throughout the profile ranges from 50 to 70 percent, by volume.

CV—Crago-Kiev association, steep (8 to 50 percent slopes). This association is about 50 percent Crago very gravelly loam and 40 percent Kiev gravelly loam. Slopes are mainly 15 to 35 percent. The Crago soil is steep and is on bench edges and ridges. The Kiev soil has slopes of 8 to 15 percent and is on foot slopes.

Included with these soils in mapping are small areas of Cabba soils and of Rock outcrop.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

The soils in this association are suited to range. Capability unit VIe-1, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Dimmick Series

The Dimmick series consists of deep, very poorly drained soils in swales. These soils formed in alluvium. Elevation ranges from 3,600 to 4,500 feet. Slopes are 0 to 2 percent. The native vegetation is mainly western and thickspike wheatgrass, basin wildrye, green needlegrass, and some forbs and woody plants. The mean annual precipitation is 12 to 14 inches, the mean an-

nual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer and subsoil are gray clay 30 inches thick. The substratum is olive clay.

Permeability is very slow. Available water capacity is high. Reaction is mildly alkaline to a depth of 18 inches and moderately alkaline below that depth. Ponding from heavy rain and run-in occurs in some years. When the soil dries, it develops cracks, 2 to 3 inches wide at the surface, that extend to a depth of as much as 30 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for small grain and for tame pasture.

Representative profile of Dimmick clay in a cultivated area, 350 feet west and 100 feet north of south-east corner of sec. 30, T. 35 N, R. 6 W.:

- Ap1—0 to 1 inch, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; vesicular crust; slightly hard, very firm, sticky and plastic; mildly alkaline; abrupt, smooth boundary.
- Ap2—1 to 4 inches, gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; moderate, very fine, granular structure; hard, very firm, sticky and plastic; mildly alkaline; abrupt, smooth boundary.
- B21—4 to 18 inches, gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; moderate, medium, prismatic structure that parts to strong, very fine angular blocks; extremely hard, extremely firm, very sticky and very plastic; mildly alkaline; gradual, smooth boundary.
- B22g—18 to 30 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; few, fine, distinct, olive (5Y 5/4 dry, 5/3 moist) mottles; moderate, coarse, prismatic structure that parts to moderate, medium and fine angular blocks; extremely hard, extremely firm, very sticky and very plastic; moderately alkaline; gradual, smooth boundary.
- Cg—30 to 60 inches, olive (5Y 5/3) clay, olive (5Y 4/3) moist, common, medium and fine, distinct, gray (5Y 5/1) mottles, dark gray (5Y 4/1) moist; massive; extremely hard, extremely firm, very sticky and very plastic; moderately alkaline.

In uncultivated areas, there is a gray or white A2 horizon 1 to 3 inches thick. The C horizon ranges from olive to greenish gray (5Y, 5GY, 5BG). Depth to lime ranges from 24 to 60 inches.

Dc—Dimmick clay. This nearly level soil is in swales. Included with this soil in mapping are a few small areas of Nishon soils.

Runoff is ponded. The hazard of water erosion is slight, and the hazard of soil blowing is slight.

This soil is suited to small grain and tame pasture. Capability unit IVw-1, dryland; Overflow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Doby Series

The Doby series consists of shallow, well-drained soils on uplands. These soils formed in material weathered from shale. Elevation ranges from 4,000 to 5,600 feet. Slopes are 4 to 60 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, and some forbs and shrubs. The mean annual precipitation is 15 to 24 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the upper part of the surface layer is dark grayish-brown clay loam 2 inches thick and the lower part is gray light clay 3 inches thick. The subsoil is gray clay 8 inches thick. The substratum is gray shaly clay 6 inches thick. Gray shale is at a depth of 19 inches.

Permeability is moderately slow. Available water capacity is very low. Reaction is neutral to a depth of 13 inches and mildly alkaline below that depth. The organic-matter content is medium in the surface layer.

These soils are used mainly for range.

Representative profile of Doby clay loam in an area of Doby-Burnette complex, hilly, in native grass, 2,300 feet east and 330 feet south of the northwest corner of sec. 17, T. 30 N., R. 11 W.:

- A11—0 to 2 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate, very fine, granular structure; slightly hard, friable, sticky and plastic; many, very fine roots; 20 percent fine shale fragments; neutral; abrupt, smooth boundary.
- A12—2 to 5 inches, gray (10YR 5/1) light clay, very dark gray (10YR 3/1) moist; moderate, very fine, granular structure; hard, friable, sticky and plastic; many, very fine roots; 20 percent fine shale fragments; neutral; clear, smooth boundary.
- B2—5 to 13 inches, gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; moderate, medium, prismatic structure that parts to moderate, medium and fine angular blocks; very hard, firm, sticky and very plastic; many, very fine roots; 20 percent fine shale fragments; neutral; clear, irregular boundary.
- C1—13 to 19 inches, gray (10YR 5/1) shaly clay, very dark gray (10YR 3/1) moist; rock structure; extremely hard, extremely firm, sticky and plastic; many, very fine roots on all shale chips; 30 percent shale chips; mildly alkaline; clear, wavy boundary.
- C2ca—19 to 60 inches, gray (10YR 5/1) shale; lime coatings along cracks.

Content of hard shale fragments ranges from 15 to 30 percent, by volume. End-over-end shaking in hexametaphosphate breaks down the hard shale fragments. The depth to soft shale ranges from 10 to 20 inches.

DH—Doby-Burnette complex, hilly (8 to 35 percent slopes). This complex is about 50 percent Doby clay loam and 45 percent Burnette cobbly or stony loam. Slopes are mainly 8 to 15 percent. The Doby soil is on ridges, hilltops, and south-facing side slopes. The Burnette soil is in swales and on north-facing side slopes. The Doby soil has the profile described as representative of the Doby series. The Burnette soil has a profile similar to that described as representative of the Burnette series, but the surface layer is cobbly or stony clay loam.

Included with these soils in mapping are about 5 percent poorly drained, gently sloping soils in small closed basins and swales.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

Soils in this complex are suited mainly to range. Capability unit VIe-1, dryland; Doby part in Shallow range site, 15- to 19-inch precipitation zone, Burnette part in Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

DL—Doby-Hanson complex, rolling (4 to 15 percent slopes). This complex is about 50 percent Doby clay

loam and 50 percent Hanson stony clay loam. Slopes are mainly 4 to 8 percent. The Doby soil is on ridges, hilltops, and south-facing side slopes. The Hanson soil is in swales and on north-facing side slopes. The Doby soil has a profile similar to that described as representative of the Doby series. The Hanson soil has a profile similar to that described as representative of the Hanson series, but the surface layer is cobbly or stony clay loam.

Included with these soils in mapping are a few small areas of poorly drained soils in swales and basins.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

Soils in this complex are well suited to native range. Capability unit VIe-1, dryland; Doby part in Shallow range site, 15- to 19-inch precipitation zone, Hanson part in Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

DS—Doby-Shale outcrop complex, very steep (20 to 60 percent slopes). This complex is about 50 percent Doby clay loam and 30 percent nearly barren Shale outcrop. Slopes are mainly 35 to 60 percent. The Doby soil is on the sides of stream valleys that are deeply entrenched in shale.

Included in mapping are about 20 percent other soils, mainly Burnette and Hanson soils.

Runoff is very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

The soil in this complex is suited mainly to range. Areas of Shale outcrop produce little or no usable forage. Small areas of lodgepole pine, fir, and aspen are on some of the north-facing side slopes. Capability unit VIIe-1, dryland; Doby part in Shallow range site, 15- to 19-inch precipitation zone, Shale outcrop part not assigned to a range site or windbreak suitability group; not assigned to a woodland suitability group; Doby soil in windbreak suitability group 4.

Dune Land

DU—Dune land (4 to 8 percent slopes). This land type consists of vegetated dunes of hard shale chips and clay granules. The topography is undulating and rolling, and the local relief is 2 to 15 feet. Elevation is about 4,800 feet. The average annual precipitation is 16 to 20 inches, and the frost-free season is 60 to 90 days. Only three areas of Dune land are mapped in the survey area; and they are 50, 90, and 150 acres in size. They are adjacent to large areas of nearly barren shale outcrop along Two Medicine Creek, 1 mile to 3 miles east of East Glacier. A representative profile is near the southeast corner of sec. 22, T. 31 N., R. 12 W.

The material is about 50 percent hard, flat shale fragments $\frac{1}{8}$ to $\frac{3}{8}$ inch in size and 50 percent sand-sized shale fragments and clay granules. This material is 3 to 5 feet thick and rests on shale, loose shale fragments, or clay glacial till. The material is non-calcareous or weakly calcareous and is mildly alkaline. The surface layer is shaly clay loam. Freshly deposited shale chips are in some grassy areas.

Permeability is moderately slow. Infiltration is moderate, and runoff is medium. The hazard of soil blowing

is severe, but where a good cover of native vegetation is maintained, blowouts are few. The available water capacity is low. Organic-matter content is low in the surface layer.

This land type is suited to range. The native vegetation is mainly rough fescue, Idaho fescue, and many shrubby cinquefoil and prairie rose shrubs. Capability unit VIe-1, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Ethridge Series

The Ethridge series consists of deep, well-drained soils on fans and terraces. These soils formed in alluvium. Elevation ranges from 3,600 to 4,200 feet. Slopes are 0 to 8 percent. The native vegetation is mainly green needlegrass, western wheatgrass, bluebunch wheatgrass, and forbs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the frost-free season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown silty clay loam 5 inches thick. The subsoil is dark grayish-brown silty clay 12 inches thick. The substratum is mostly very pale brown or light brownish-gray silty clay loam.

Permeability is moderately slow. Available water capacity is moderate or high. Reaction is neutral to a depth of 5 inches, mildly alkaline to a depth of 13 inches, and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are mainly used for dryfarmed small grain, pasture, and range. Some areas are irrigated and used for small grains, hay, and pasture.

Representative profile of Ethridge silty clay loam, 0 to 2 percent slopes, in a cultivated field, 2,200 feet south and 400 feet west of the northeast corner of sec. 25, T. 32 N., R. 5 W.:

- Ap—0 to 5 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; hard, friable, slightly sticky and slightly plastic; neutral; abrupt, smooth boundary.
- B2t—5 to 13 inches, dark grayish-brown (10YR 4/2) silty clay, dark brown (10YR 4/3) moist; strong, medium to very fine, subangular blocky structure; very hard, firm, sticky and plastic; common clay films on peds; many, fine and very fine, horizontal and vertical, tubular pores; many, fine roots; mildly alkaline; clear, irregular boundary.
- B3—13 to 17 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure that parts to strong, medium angular blocks; very hard, firm, sticky and plastic; few, very thin, discontinuous clay films on vertical ped surfaces; common, fine and very fine, horizontal and vertical, tubular pores; few, fine roots; slight effervescence; moderately alkaline; gradual, wavy boundary.
- C1ca—17 to 28 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure; hard, friable, sticky and plastic; few, fine, horizontal and vertical, tubular pores; few, fine roots; strong effervescence; common, soft nodules of lime; moderately alkaline; gradual, wavy boundary.
- C2ca—28 to 46 inches, very pale brown (10YR 7/3) stratified silt and clay, grayish brown (10YR 5/2) moist; massive; hard, very friable, sticky and plastic; few, fine, vertical, tubular pores; very few, fine roots; strong effervescence; many, soft masses

of lime; moderately alkaline; gradual, wavy boundary.

C3ca—46 to 60 inches, light brownish-gray (2.5Y 6/2) stratified silt and clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; few, fine and very fine, vertical pores; strong effervescence; common, soft masses of lime; moderately alkaline; gradual, wavy boundary.

C4cs—60 to 66 inches, light brownish-gray (2.5Y 6/2) stratified silt and clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; strong effervescence; many crystals of segregated gypsum; moderately alkaline.

The Ap horizon is clay loam or silty clay loam.

Ec—Ethridge clay loam, sand substratum, 0 to 2 percent slopes. This nearly level soil is on fans and terraces. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and sand is in the substratum at a depth of 30 to 40 inches.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Permeability is moderately slow to a depth of 30 to 40 inches and rapid below that depth.

This soil is suited to dryfarmed small grain, pasture, hay, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Ed—Ethridge clay loam, sand substratum, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and sand is in the substratum at a depth of 30 to 40 inches.

Included with this soil in mapping are a few small areas of Attewan or Brockway soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Permeability is moderately slow to a depth of 30 to 40 inches and rapid below that depth.

This soil is suited to dryfarmed small grain, hay, pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Ee—Ethridge clay loam, sand substratum, 4 to 8 percent slopes. This moderately sloping soil is on fans and terraces. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and sand is in the substratum at a depth of 30 to 40 inches.

Included with this soil in mapping are a few small areas of Attewan soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Permeability is moderately slow to a depth of 30 or 40 inches and rapid below that depth.

This soil is suited to dryfarmed small grain, hay, pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Eg—Ethridge silty clay loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small

areas of Ethridge soils that have a surface layer of clay loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Permeability is moderately slow.

This soil is suited to dryfarmed and irrigated small grain, pasture, hay, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Eh—Ethridge silty clay loam, 2 to 4 percent slopes. This gently sloping soil is on terraces and fans.

Included with this soil in mapping are a few small areas of Ethridge soils that have a surface layer of clay loam.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Permeability is moderately slow.

This soil is suited to dryfarmed and irrigated small grain, pasture, hay, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Em—Ethridge-Absher clay loams, 0 to 2 percent slopes. This complex of nearly level soils is on terraces and fans. This complex is about 75 percent Ethridge clay loam and about 20 percent Absher clay loam. The Ethridge soil has a profile similar to that described as representative of the Ethridge series, but the surface layer is clay loam. The Absher soil has a profile similar to that described as representative of the Absher series.

Included with these soils in mapping, and making up about 5 percent of the mapped areas, are soils that have a surface layer of gravelly clay loam. Also included are a few small areas of somewhat steeper soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Permeability is moderately slow in the Ethridge soil and very slow in the Absher soil.

These soils are suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability unit IIIe-3, dryland; Ethridge part in Clayey range site, 12- to 14-inch precipitation zone, Absher part in Dense Clay range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Ethridge part in windbreak suitability group 2L, Absher part in windbreak suitability group 4.

Fairfield Series

The Fairfield series consists of deep, well-drained soils on terraces and fans. These soils formed in alluvium. Elevation ranges from 3,800 to 4,500 feet. Slopes are 0 to 8 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, western and thickspike wheatgrass, and green needlegrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is dark-gray gravelly loam 4 inches thick. The subsoil is brown gravelly clay loam 6 inches thick. The substratum is

mostly white and pale-yellow clay loam to a depth of 60 inches.

Permeability is moderately slow. Available water capacity is high. Reaction is neutral and mildly alkaline in the upper 10 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are mainly used for dryfarmed small grain, tame pasture, and range. Some areas are used for irrigated small grain, for tame pasture, and alfalfa hay.

Representative profile of Fairfield gravelly loam, 0 to 2 percent slopes, in native grass, 1,350 feet west and 500 feet south of northeast corner of sec. 29, T. 33 N., R. 8 W.:

- A1—0 to 4 inches, dark-gray (10YR 4/1) gravelly loam, very dark brown (10YR 2/2) moist; weak, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; 20 percent pebbles; neutral; abrupt, smooth boundary.
- B2t—4 to 10 inches, brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; strong, medium prismatic structure that parts to moderate, fine and medium, angular blocks; slightly hard, friable, sticky and plastic; clay bridging sand grains; 20 percent pebbles; mildly alkaline; abrupt, irregular boundary.
- C1ca—10 to 17 inches, white and grayish-brown (10YR 8/1 and 5/2) light clay loam, light brownish gray (2.5Y 6/2) moist; weak, coarse, prismatic structure; slightly hard, friable, sticky and plastic; 10 percent pebbles; strong effervescence; many fine pellets of soft lime in places; moderately alkaline; clear, irregular boundary.
- C2ca—17 to 45 inches, white (10YR 8/1) clay loam, very pale brown (10YR 7/3) moist; weak, coarse, prismatic structure; hard, firm, sticky and plastic; 10 percent pebbles; strong effervescence; nearly continuous mass of fine pellets of soft lime; moderately alkaline; clear, irregular boundary.
- C3ca—45 to 60 inches, pale-yellow (2.5Y 7/4) light clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm, sticky and plastic; 10 percent pebbles; strong effervescence but less segregated lime than in horizon above; moderately alkaline; abrupt, smooth boundary to loose very gravelly sand.

Content of rock fragments ranges from 5 to 30 percent, by volume.

Fa—Fairfield loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is loam.

Included with this soil in mapping are a few small areas of Fairfield gravelly loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to irrigated small grain, tame pasture, and alfalfa hay. Where dryfarmed this soil is also suited to small grain, tame pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Fb—Fairfield loam, 2 to 4 percent slopes. This gently sloping soil is on terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer is loam.

Included with this soil in mapping are a few small areas of Fairfield gravelly loam.

Runoff is medium. The hazard of water erosion is

slight or moderate, and the hazard of soil blowing is moderate.

This soil is well suited to irrigated small grain, tame pasture, and alfalfa hay. Where dryfarmed this soil is also suited to small grain, tame pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Fc—Fairfield loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer is loam and in most areas shale is at a depth of 4 to 6 feet.

Included with this soil in mapping are a few small areas of Martinsdale and Arnegard soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is well suited to dryfarmed grain and tame pasture and to range. It is suited to irrigated small grain, tame pasture, and alfalfa hay. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Fd—Fairfield gravelly loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Fairfield loam and Martinsdale clay loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to irrigated small grain, tame pasture, and alfalfa hay. Where dryfarmed, this soil is also suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Fe—Fairfield gravelly loam, 2 to 4 percent slopes. This gently sloping soil is on terraces.

Included with this soil in mapping are a few small areas of Fairfield loam. Also included are small areas of a soil that has slopes of 0 to 2 percent.

Runoff is medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is well suited to irrigated small grain, tame pasture, and alfalfa hay. When dryfarmed, this soil is also suited to small grain, tame pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Ff—Fairfield gravelly loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces and fans. It has a profile similar to that described as representative of the series, but in most areas shale is at a depth of 4 to 6 feet.

Included with this soil in mapping are a few small areas of Fairfield loam. Also included are small areas of Martinsdale clay loam and Arnegard loam.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is well suited to dryfarmed small grain and

tame pasture and to range. It is suited to irrigated small grain, tame pasture, and alfalfa hay. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Fg—Fairfield cobbly loam, 0 to 4 percent slopes. This nearly level or gently sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is cobbly loam.

Included with this soil in mapping are a few small areas of Fairfield loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. It is suited to irrigated small grain, tame pasture, and alfalfa hay. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Fh—Fairfield-Cabba complex, sloping (4 to 8 percent slopes). This complex is on uplands. It is about 65 percent Fairfield loam and 30 percent Cabba loam. The Cabba soil is on ridges and the steeper parts of side slopes. The Fairfield soil has a profile similar to that described as representative of the Fairfield series, but the surface layer is loam and shale is at a depth of 4 to 5 feet. The Cabba soil has a profile similar to that described as representative of the Cabba series.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are Rock outcrop and Boxwell soils.

Runoff is moderate. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Fairfield part in Silty range site, 12- to 14-inch precipitation zone, Cabba part in Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Fairfield part in windbreak suitability group 3L, Cabba part in windbreak suitability group 3M.

Fk—Fairfield-Utica gravelly loams, 0 to 2 percent slopes. This complex of nearly level soils is on terraces. This complex is about 75 percent Fairfield gravelly loam and 20 percent Utica gravelly loam or very gravelly sandy loam. The surface of the Utica soils is 3 to 10 inches higher than the surface of the Fairfield soil. The Fairfield soil has a profile similar to that described as representative of the Fairfield series, but the gravel is limestone rather than argillite and quartzite. The Utica soils have a profile similar to that described as representative of the Utica series.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are areas of soils that have slopes of 2 to 5 percent.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The Utica soils are droughty, and there generally is a contrast in vegetative growth.

These soils are suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Fairfield part in Silty range site, 12- to 14-inch precipitation zone, Utica part in Shallow to Gravel range site, 12-

to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Farnuf Series

The Farnuf series consists of deep, well-drained soils on fans and terraces. These soils formed in alluvium. Elevation ranges from 4,200 to 5,000 feet. Slopes are 0 to 15 percent. The native vegetation is mainly rough fescue, Idaho fescue, bluebunch wheatgrass, and some forbs and woody plants. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is dark grayish-brown cobbly loam 4 inches thick. The subsoil is brown and light brownish-gray light clay loam and sandy clay loam 12 inches thick. The substratum is light brownish-gray light clay loam to a depth of 34 inches and light brownish-gray gravelly sandy loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is moderate or high. Reaction is neutral to a depth of 12 inches, mildly alkaline between depths of 12 and 16 inches, and moderately alkaline below a depth of 16 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for range, small grain, and tame pasture.

Representative profile of Farnuf cobbly loam, 2 to 4 percent slopes, in native grass, 1,500 feet south and 150 feet west of center of sec. 36, T. 35 N., R. 11 W.:

- A1—0 to 4 inches, dark grayish-brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; neutral; clear, irregular boundary.
- B2t—4 to 12 inches, brown (10YR 5/3) light clay loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure that parts to weak, medium angular blocks; slightly hard, friable, slightly sticky and slightly plastic; thin, continuous, clay films on peds; neutral; clear, wavy boundary.
- B3ca—12 to 16 inches, light brownish-gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; moderate, medium, prismatic structure; hard, friable, slightly sticky and slightly plastic; many, very fine threads of white lime; mildly alkaline; clear, wavy boundary.
- C1ca—16 to 34 inches, light brownish-gray (10YR 6/2) light clay loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure; hard, friable, slightly sticky and slightly plastic; common, medium, distinct masses of soft, white (10YR 8/2) lime, a few hard lime coats on pebbles; moderately alkaline; gradual, irregular boundary.
- C2ca—34 to 60 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, grayish brown (10YR 5/2) moist; massive; 25 percent pebbles; common, medium masses of soft lime, a few hard lime coatings on pebbles; moderately alkaline.

The A1 horizon is loam or cobbly loam. To a depth of 34 inches, content of rock fragments ranges from 0 to 35 percent, by volume, and below this depth it ranges from 0 to 40 percent.

Fm—Farnuf loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans and terraces.

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

light clay loam. Also included are small areas of Savage, Gallatin, and Rhoades soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to range, tame pasture, and small grain. Capability unit IIIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Fn—Farnuf cobbly loam, 0 to 2 percent slopes. This nearly level soil is on terraces.

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

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to small grain. It is also suited to tame pasture and range. Capability unit IIIe-1, dryland; Silty range site 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Fo—Farnuf cobbly loam, 2 to 4 percent slopes. This gently 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 slopes of 0 to 2 percent. Also included are a few small areas of soils that have somewhat greater slopes.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to small grain. It is also suited to tame pasture and range. Capability unit IIIe-2, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Fr—Farnuf cobbly loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces.

Included with this soil in mapping are a few small areas of soils in which the lower part of the subsoil is finer textured than that of Farnuf soils. Also included are areas of soils that have somewhat greater slopes and some areas of soils that do not have a cobbly surface layer. Some small areas have weathered shale at a depth of 4 to 5 feet. A few small areas of Arnegard soils are also included.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IIIe-2, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Fs—Farnuf cobbly loam, 8 to 15 percent slopes. This moderately steep soil is on terraces. Included with this soil in mapping are a few small areas of soils that have weathered shale at a depth of 4 to 5 feet. Also included are small areas of soils in which the lower part of the subsoil is finer textured than that of Farnuf soils. Small areas of Pishkun soils and Farnuf soils that have slopes somewhat greater than 15 percent are also included.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is suited to range. It is suited to tame pasture. Capability unit IVe-2, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to

a woodland suitability group; windbreak suitability group 2L.

Fifer Series

The Fifer series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in material weathered from shale. Elevation ranges from 4,500 to 5,500 feet. Slopes are 4 to 60 percent. The native vegetation is mainly rough fescue, blue-bunch wheatgrass, and some forbs and shrubs. The mean annual precipitation is 16 to 24 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 95 days.

In a representative profile the surface layer is dark-gray loam 6 inches thick. The underlying material is gray and greenish-gray silty clay loam 14 inches thick over light greenish-gray shale.

Permeability is moderate. Available water capacity is very low or low. Reaction is neutral to a depth of 6 inches and mildly alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are mainly used for range.

Representative profile of Fifer loam, hilly, in native grass, 1,300 feet north and 800 feet east of the southeast corner of sec. 10, T. 37 N., R. 14 W.:

A11—0 to 2 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate, very fine, crumb structure; slightly hard, very friable, slightly sticky and nonplastic; many roots; neutral; clear, smooth boundary.

A12—2 to 6 inches, dark gray (10YR 4/1) loam, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, angular blocky structure; hard, friable, slightly sticky and nonplastic; many roots; slight effervescence; neutral; clear, wavy boundary.

C1ca—6 to 11 inches, gray (5Y 6/1) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure that parts to weak, very fine angular blocks; hard to very hard, friable, sticky and slightly plastic; olive-gray (5Y 5/2) coats, moist; many roots; strong effervescence; mildly alkaline; gradual, wavy boundary.

C2ca—11 to 20 inches, greenish-gray (5GY 6/1) silty clay loam, greenish-gray (5GY 5/1) moist; weak, coarse, prismatic structure that parts to strong, fine angular blocks; extremely hard, firm, sticky and plastic; dark grayish-brown (2.5Y 4/2) coats on prisms, moist; roots mainly between prisms; mildly alkaline; clear, wavy boundary.

C3—20 to 60 inches, light greenish-gray (5GY 7/1) shale.

The A horizon ranges from 5 to 11 inches in thickness. Depth to underlying soft shale or sandstone ranges from 10 to 20 inches. Content of pebbles or channers ranges from 0 to 10 percent, by volume, throughout.

Ft—Fifer loam, hilly (8 to 15 percent slopes). This soil is on dissected shale uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small outcrops of barren shale or sandstone on ridges and hill-tops. Also included are small areas of Adel and Bynum soils in swales or on north-facing side slopes.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

This soil is suited mainly to range. Capability unit VIe-1, dryland; Shallow range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

FU—Fifer-Cheadle-Rock outcrop complex, very steep (15 to 60 percent slopes). This complex is on uplands. It is about 35 percent Fifer loam, 30 percent Cheadle flaggy sandy loam, and 30 percent shale or sandstone outcrop. Slopes are mainly 15 to 35 percent. The Fifer soil has a profile similar to that described as representative of the Fifer series. The Cheadle soil has the profile described as representative of the Cheadle series.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are Adel, Doby, and Pishkun soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited mainly to range. The areas of Rock outcrop produce little or no usable forage. Capability unit VIIe-1, dryland; Fifer and Cheadle parts in Shallow range site, 15- to 19-inch precipitation zone, Rock outcrop part not assigned to a range site or windbreak suitability group; not assigned to a woodland suitability group; windbreak suitability group 4.

FV—Fifer-Raynesford complex, hilly (8 to 30 percent slopes). This complex is on uplands. It is about 40 percent Fifer loam and 40 percent Raynesford gravelly loam. Slopes are mainly 8 to 15 percent.

Included with these soils in mapping, and making up about 20 percent of the mapped areas, are Cheadle, Bynum, Adel, and Hanson soils. Also included are a few small areas of barren shale or sandstone outcrops and wet basins.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited mainly to range. Capability unit VIe-1, dryland; Fifer part in Shallow range site, 15- to 19-inch precipitation zone, Raynesford part in Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Fresh Water Swamp

FW—Fresh water swamp (0 to 2 percent slopes). This land type consists of wet mineral and organic soils derived mostly from recent alluvial deposits near the mountains. Areas of these soils are commonly narrow, and the total extent of the unit is small. The frost-free period is about 60 days, and annual precipitation is 18 to 24 inches.

Mapped areas are as much as 50 percent water or intermittent water in places. Beaver dams and runoff moving through brush-clogged, narrow drainageways cause ponding and wet soils.

Vegetation is mainly willows and an understory of sedges and rushes. The vegetation and wetness make the use of these soils for grazing very difficult. These areas are well suited to wildlife habitat. Capability unit VIIIw-1, dryland; not assigned to a range site or a woodland suitability group; windbreak suitability group 4.

Gallatin Series

The Gallatin series consists of deep, somewhat

poorly drained soils on low terraces. These soils formed in alluvium. Elevation ranges from 4,200 to 4,800 feet. Slopes are 0 to 2 percent. The native vegetation is mainly basin wildrye, prairie cordgrass, low and tall sedges, and northern reedgrass. The mean annual precipitation is 14 to 19 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 80 to 100 days.

In a representative profile the surface layer is dark-gray loam 38 inches thick. The underlying material is light-gray stratified loam, sandy loam, and silty clay loam.

Permeability is slow. Available water capacity is high. The seasonal water table is at a depth of 4 or 5 feet. Reaction is mildly alkaline. Organic-matter content is high in the surface layer.

This soil is used mainly for dryfarmed small grain, tame pasture, and range.

Representative profile of Gallatin loam in native grass, 200 feet south and 1,400 feet east of northwest corner of sec. 4, T. 33 N., R. 10 W.:

A11—0 to 3 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate, fine, granular structure; soft, friable, slightly sticky and slightly plastic; many, fine and very fine roots; slight effervescence; mildly alkaline; clear, wavy boundary.

A12—3 to 38 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, fine, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common, fine and very fine roots; slight effervescence; mildly alkaline; gradual, wavy boundary.

C—38 to 60 inches, light-gray (5Y 7/1) loam, sandy loam, and silty clay loam in one- to three-inch strata, dark gray (5Y 4/1) moist; many, fine, prominent, brown and reddish-brown mottles; massive; slightly hard, friable, sticky and slightly plastic; slight effervescence; mildly alkaline.

The A horizon ranges from 16 to 40 inches in thickness. The C horizon is uniform clay or silty clay loam in places rather than stratified. Distinct or prominent, brown and reddish-brown mottles are below a depth of 36 inches.

Ga—Gallatin loam (0 to 2 percent slopes). This nearly level, somewhat poorly drained soil is on low terraces.

Included with this soil in mapping are small low areas and meander channels that are more poorly drained than Gallatin soils.

Runoff is slow. The hazards of water erosion and soil blowing are slight. The water table is at a depth of 4 or 5 feet for a short period in spring.

This soil is suited mainly to dryfarmed small grain, tame pasture, hay, and range. Where drained, this soil is well suited to irrigation, but only a few areas are currently irrigated. Capability unit IIIw-1, dryland; Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Gapo Series

The Gapo series consists of deep, poorly drained soils on bottoms and terraces. These soils formed in alluvium. Elevation ranges from 4,200 to 5,000 feet. Slopes are 0 to 2 percent. The native vegetation is mainly basin wildrye, prairie cordgrass, low and tall sedges, and northern reedgrass. The mean annual precipitation is 14 to 20 inches, the mean annual air

temperature is 39° to 41° F, and the growing season is 80 to 100 days.

In a representative profile the surface layer and subsoil are gray clay loam 42 inches thick. The substratum is very gravelly sand.

Permeability is moderately slow to a depth of 16 inches and slow below that depth. Available water capacity is moderate. The depth to a fluctuating seasonal water table ranges from 1 to 3 feet. Reaction is moderately alkaline. Organic-matter content is high in the surface layer.

These soils are mainly used for range. Some areas are used for tame pasture.

Representative profile of Gapo clay loam in a cultivated field, 2,400 feet north and 50 feet east of the southwest corner of sec. 36, T. 32 N., R. 9 W.:

Ap—0 to 7 inches, gray (5Y 5/1) clay loam, very dark gray (10YR 3/1) moist; strong, very fine, granular structure; hard, very friable, slightly sticky and slightly plastic; many, very fine roots; violent effervescence; moderately alkaline; abrupt, smooth boundary.

A12—7 to 16 inches, gray (5Y 5/1) clay loam, very dark gray (10YR 3/1) moist; few, very fine, prominent, strong-brown (7.5YR 5/6) mottles; strong, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many, very fine roots; violent effervescence; moderately alkaline; clear, irregular boundary.

B1g—16 to 28 inches, gray (5Y 6/1) clay loam, dark gray (5Y 4/1) moist; common, very fine, prominent, brown and yellowish-brown (10YR 5/3 and 5/4) mottles; strong, fine, angular blocky structure; very hard, friable, sticky and plastic; common, very fine roots; violent effervescence; moderately alkaline; clear, smooth boundary.

B2g—28 to 42 inches, gray (5Y 6/1) heavy clay loam, dark gray (5Y 4/1) moist; massive; very hard, firm, sticky and plastic; common, very fine roots; moderately alkaline; gradual, smooth boundary.

IIC—42 to 60 inches, very gravelly sand; 60 percent rounded argillite and quartzite pebbles.

Where undisturbed, the soil has a 1- to 3-inch root mat over the mineral soils and the upper 3 to 4 inches of the A horizon is free of carbonates. The B horizon ranges from clay loam to silty clay. The IIC horizon ranges from very gravelly sand that is 50 to 70 percent pebbles to silty clay. There are a few cobbles in some places.

Gc—Gapo clay loam (0 to 2 percent slopes). This nearly level soil is on terraces and bottoms in the large valleys. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of very poorly drained soils and some areas of soils in which clay loam or gravelly clay loam is below a depth of 42 inches.

Runoff is slow. The hazards of water erosion and soil blowing are slight. There is a fluctuating water table at a depth of 2 feet for part of the growing season.

This soil is suited mainly to native hay and range. Where drained, it is suited to irrigated hay and tame pasture. Capability unit Vw-1, dryland; Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3W.

Gd—Gapo clay loam, drained (0 to 2 percent slopes). This nearly level soil is on terraces and bottoms mainly in valleys in the uplands. It has a profile similar to that described as representative of the series, but it

is significantly better drained, the surface layer is leached of lime, and the subsoil and substratum are silty clay. Annual precipitation is 16 to 20 inches.

Included with this soil in mapping are a few small areas of very poorly drained soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The water table is generally below a depth of 4 feet during the growing season but may be above a depth of 3 feet for a short period in the spring.

This soil is well suited to tame pasture and native range. It is also suited to irrigated hay and tame pasture. Capability unit IVE-4, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2W.

Garlet Series

The Garlet series consists of deep, well-drained stony soils on hills, ridges, and foot slopes of the mountains. These soils formed in alluvium and glacial till of mixed mineralogy. Elevation ranges from 5,000 to 6,500 feet. Slopes are 25 to 60 percent. The native vegetation is mainly lodgepole pine and a few scattered groves of aspen. The understory is mainly shrubs and forbs. The mean annual precipitation is 20 to 35 inches, the mean annual air temperature is 34° to 38° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is overlain by 2 inches of forest litter. The surface layer is gray and light brownish-gray stony loam and very cobbly loam 19 inches thick. The subsoil is pinkish-gray very cobbly light sandy clay loam 27 inches thick. The substratum is light brownish-gray very cobbly loam.

Permeability is rapid. Available water capacity is low. Reaction is medium acid or slightly acid to a depth of 19 inches, mildly alkaline between depths of 19 and 46 inches, and moderately alkaline below a depth of 46 inches. Organic-matter content is low in the surface layer.

Representative profile of Garlet stony loam, very steep, in woodland, 2,400 feet east and 600 feet south of the northwest corner of sec. 21, T. 32 N., R. 13 W.:

O1—2 inches to 1 inch, needles, twigs, and grass leaves.

O2—1 inch to 0, decomposed dark-colored organic material with many, fine roots.

A21—0 to 4 inches, gray (10YR 6/1) stony loam, dark gray (10YR 4/1) moist; weak, thin, platy structure that parts to weak, very fine, crumbs; soft, very friable, nonsticky and nonplastic; 20 percent pebbles, cobbles, and stones; many fine and common coarse roots; medium acid; abrupt, smooth boundary.

A22—4 to 19 inches, light brownish-gray (10YR 6/2) very cobbly loam, brown (10YR 5/3) moist; weak, very fine, crumb structure; soft, very friable, slightly sticky and slightly plastic; common, very fine pores; many, fine and medium roots; 70 percent pebbles, cobbles, and stones; slightly acid; clear, irregular boundary.

B&A—19 to 46 inches, pinkish-gray (7.5YR 6/2) very cobbly light sandy clay loam, brown (7.5YR 5/2) moist; common, fine mottles of brown (7.5YR 5/4); moderate, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few, gray very fine sand grains on peds; common, fine and very fine pores; com-

mon, medium and fine roots; 70 percent pebbles, cobbles, and stones; mildly alkaline; clear, smooth boundary.

Cca—46 to 70 inches, light brownish-gray (10YR 6/2) very cobbly loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 70 percent pebbles, cobbles, and stones; strong effervescence; lime coats on lower sides of rock fragments; moderately alkaline.

The A2 horizon is covered by 1 inch to 3 inches of forest litter. The content of rock fragments throughout the profile ranges from 40 to 75 percent, by volume. The depth to lime ranges from 40 to 60 inches.

GL—Garlet stony loam, very steep (25 to 60 percent slopes). This soil is on foot slopes and landslides along the mountains. Slopes are mainly 35 to 60 percent.

Included with this soil in mapping are a few small areas of Rock outcrop and some seep areas. Also included are small areas that have only a few stones on the surface and small areas of Loberg, Whitore, Swifton, Tenex, and Libeg soils.

Runoff is rapid. The hazards of water erosion and soil blowing are slight or moderate.

This soil is suited mainly to woodland, wildlife habitat, and watershed. Capability unit VIIe-1, dryland; not assigned to a range site; woodland suitability group 6x1; windbreak suitability group 4.

Hanson Series

The Hanson series consists of deep, well-drained stony soils on hills, ridges, and foot slopes. These soils formed in calcareous glacial till. Elevation ranges from 4,300 to 6,000 feet. Slopes are 2 to 35 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and some forbs and shrubs. The mean annual precipitation is 15 to 20 inches, but a few areas have as much as 24 inches. The mean annual air temperature is 37° to 41°F, and the growing season is 60 to 95 days.

In a representative profile the surface layer is dark grayish-brown stony loam 12 inches thick. The underlying material is light-gray and white very stony loam.

Permeability is moderately slow. Available water capacity is low. Reaction is neutral to a depth of 4 inches, mildly alkaline between depths of 4 and 15 inches, and moderately alkaline below a depth of 15 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly as range.

Representative profile of a Hanson stony loam in an area of Babb-Hanson complex, hilly, in native range, 400 feet south and 100 feet east of the center of sec. 29, T. 36 N., R. 13 W.:

A11—0 to 4 inches, very dark grayish-brown (10YR 3/2) stony loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; many, clear, unstained sand grains; 40 percent pebbles, cobbles, and stones; neutral; clear, smooth boundary.

A12—4 to 12 inches, dark grayish-brown (10YR 4/2) stony loam, dark brown (10YR 3/3) moist; weak, fine and medium, angular blocky structure; soft, very friable, nonsticky and nonplastic; 40 percent pebbles, cobbles, and stones; mildly alkaline; clear, smooth boundary.

C1ca—12 to 15 inches, light-gray (10YR 7/2) very stony loam, grayish brown (10YR 5/2) moist; weak, medium, angular blocky structure; soft, friable, slightly sticky and nonplastic; 60 percent pebbles,

cobbles, and stones; slight effervescence; lime on the lower sides of many rock fragments; mildly alkaline; clear, irregular boundary.

C2ca—15 to 23 inches, white (10YR 8/2) very stony loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable, slightly sticky and nonplastic; 60 percent pebbles, cobbles, and stones, many of which are limestone; violent effervescence; lime on all rock fragments; moderately alkaline; clear, wavy boundary.

C3ca—23 to 32 inches, light-gray (10YR 7/2) very stony loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and nonplastic; 60 percent pebbles, cobbles, and stones; strong effervescence; moderately alkaline; gradual, wavy boundary.

C4—32 to 60 inches, light-gray (10YR 7/2) very stony loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and nonplastic; 60 percent pebbles, cobbles, and stones; strong effervescence; very little segregated lime; moderately alkaline.

The A1 horizon is stony loam or stony clay loam. The depth to calcareous material ranges from 4 to 12 inches. In places pebbles and cobbles predominate, but stones are common in the A1 horizon in most areas. The content of rock fragments throughout the soil ranges from 40 to 70 percent, by volume.

HA—Hanson stony loam, steep (15 to 35 percent slopes). This soil is on hills and ridges. It has a profile similar to that described as representative of the series, but the noncalcareous surface layer is not so dark colored and is about 6 inches thick.

Included with this soil in mapping are a few small areas of soils that have somewhat greater slopes. Small areas of Adel and Raynesford soils on foot slopes and in concave areas are also included.

Runoff is rapid. The hazard of water erosion is moderate or severe, and the hazard of soil blowing is slight or moderate.

This soil is suited mainly to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

HF—Hanson-Fifer complex, rolling (4 to 15 percent slopes). This complex is on uplands. It is about 50 percent Hanson stony loam and 40 percent Fifer loam. Slopes are mainly 4 to 8 percent. Hanson stony loam is mainly on ridges and tops of hills. Hanson and Fifer soils have profiles similar to those described as representative of their respective series, but the surface layer is thinner and not so dark colored. In most areas, the Hanson soil has few stones in the surface layer.

Included with these soils in mapping, and making up about 10 percent of the mapped areas, are other soils, mainly Raynesford gravelly loam, in swales and on foot slopes. Also included are a few small wet basins and waterways.

Runoff is medium or rapid. The hazard of water erosion is moderate. The hazard of soil blowing is slight or moderate.

These soils are suited mainly to range. Capability unit VIe-1, dryland; Hanson part in Silty range site, 15- to 19-inch precipitation zone, Fifer part in Shallow range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

HR—Hanson-Raynesford complex, undulating (2 to 8 percent slopes). This complex is 50 percent Hanson

stony loam and 50 percent Raynesford gravelly loam. Slopes are mainly 2 to 4 percent. Hanson stony loam is on hills and ridges, and Raynesford gravelly loam is in depressions and on foot slopes in the uplands. The Hanson and Raynesford soils have profiles similar to those described as representative of their respective series, but the surface layer is thinner and not so dark colored. In most areas, the Hanson soil has only a few stones, but the surface layer is very gravelly or cobbly.

Included with these soils in mapping are small areas of poorly drained soils in closed basins and swales.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

These soils are suited mainly to native range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; Hanson part in windbreak suitability group 3M, Raynesford part in windbreak suitability group 2L.

HS—Hanson-Raynesford complex, rolling (4 to 20 percent slopes). This complex is 60 percent Hanson stony loam and 40 percent Raynesford gravelly loam. Slopes are mainly 4 to 8 percent. Hanson stony loam is on hills and ridges, and Raynesford gravelly loam is in concave areas and on foot slopes in the uplands. The Hanson and Raynesford soils have profiles similar to those described as representative of their respective series, but the surface layer is thinner and not so dark colored. In some areas, the Hanson soil has only a few stones, but the surface layer is very gravelly or cobbly.

Included with these soils in mapping are small areas of poorly drained soils in swales and closed basins. Also included are a few small areas where the mantle of glacial till is thin over shale.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

These soils are suited mainly to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; Hanson part in windbreak suitability group 3M, Raynesford part in windbreak suitability group 2L.

Kevin Series

The Kevin series consists of deep, well-drained soils on uplands. These soils formed in glacial till. Elevation ranges from 3,600 to 4,300 feet. Slopes are 2 to 15 percent. The native vegetation is mainly bluebunch wheatgrass, western and thickspike wheatgrass, green needlegrass, and needleandthread. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown loam 6 inches thick. The subsoil is light brownish-gray clay loam 4 inches thick. The upper part of the substratum is light-gray silty clay loam 12 inches thick and the lower part is light brownish-gray, grayish-brown, and light yellowish-brown clay loam.

Permeability is slow. Available water capacity is

high. Reaction is mildly alkaline to a depth of 10 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed small grain, tame pasture, and range.

Representative profile of Kevin loam, 2 to 4 percent slopes, in a cultivated field, 1,000 feet south and 250 feet west of northeast corner of sec. 30, T. 37 N., R. 5 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; abrupt, smooth boundary.

B2t—6 to 10 inches, light brownish-gray (10YR 6/2) clay loam, brown (10YR 4/3) moist; weak, medium, prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; 5 percent pebbles; grayish-brown (10YR 5/2) clay films; slight effervescence; mildly alkaline; gradual, smooth boundary.

C1ca—10 to 22 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; slightly hard, friable, sticky and plastic; 5 percent pebbles; strong effervescence; many, fine nodules of segregated lime; moderately alkaline; clear, wavy boundary.

C2ca—22 to 40 inches, light brownish-gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, sticky and plastic; 5 percent pebbles; strong effervescence; moderately alkaline; clear, wavy boundary.

C3cs—40 to 52 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, sticky and plastic; 5 percent pebbles; strong effervescence; many, medium masses of gypsum; moderately alkaline; gradual, wavy boundary.

C4cs—52 to 66 inches, light yellowish-brown (2.5Y 6/4) heavy clay loam, olive brown (2.5Y 4/4) moist; massive; hard, firm, very sticky and plastic; 5 percent pebbles; strong effervescence; moderately alkaline.

In places there are a few cobbles and stones. The Ap horizon is loam or clay loam in places. The B2t horizon ranges from 4 to 8 inches in thickness.

Ka—Kevin loam, 2 to 4 percent slopes. This gently sloping soil has the profile described as representative of the series.

Included with this soil in mapping are a few, small, concave areas of Scobey clay loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain and tame pasture. It is also suited to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Kb—Kevin loam, 4 to 8 percent slopes. This moderately sloping soil has a profile similar to that described as representative of the series, but the combined thickness of the surface layer and subsoil ranges from 10 to 15 inches.

Included with this soil in mapping are a few small areas of soils that have a gravelly surface layer. Also included are small areas of Scobey clay loam.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is well suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned

to a woodland suitability group; windbreak suitability group 2L.

Kc—Kevin clay loam, 2 to 4 percent slopes. This gently sloping soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is clay loam about 8 inches thick.

Included with this soil in mapping are a few small areas of soils that have a surface layer of light clay. Also included are small areas of Scobey clay loam.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain and tame pasture. It is also suited to range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Kd—Kevin clay loam, 4 to 8 percent slopes. This moderately sloping soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is clay loam about 8 inches thick.

Included with this soil in mapping are a few small areas of Scobey clay loam.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is well suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Ke—Kevin clay loam, 8 to 15 percent slopes. This moderately steep soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is clay loam.

Included with this soil in mapping are a few small areas of soils that have a surface layer of light clay. Also included are small areas of Sunburst soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IVe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Kiev Series

The Kiev series consists of deep, well-drained soils on terraces, on fans, and on uplands. These soils formed in alluvium. Elevation ranges from 3,800 to 4,400 feet. Slopes are 0 to 15 percent. The native vegetation is mainly bluebunch wheatgrass, needleand-thread, western wheatgrass, and some forbs and shrubs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the frost-free season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown gravelly loam 2 inches thick. The upper part of the subsoil is dark grayish-brown gravelly clay loam 5 inches thick, and the lower part is pale-brown loam 5 inches thick. The substratum is white or gray silt loam.

Permeability is moderate. Available water capacity is moderate. Reaction is mildly alkaline to a depth

of 7 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are mainly used for dryfarmed and irrigated small grain, tame pasture, irrigated alfalfa hay, and range.

Representative profile of Kiev gravelly loam, 2 to 4 percent slopes, in native grass, 600 feet south and 400 feet east of center of sec. 14, T. 31 N., R. 8 W.:

- A1—0 to 2 inches, grayish-brown (2.5Y 5/2) gravelly loam, very dark grayish brown (2.5Y 3/2) moist; weak, fine, crumb structure; slightly hard, friable, non-sticky and nonplastic; 15 percent pebbles; mildly alkaline; clear, wavy boundary.
- B2—2 to 7 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, angular blocky structure that parts to moderate, fine and very fine granules; hard, friable, slightly sticky and slightly plastic; 15 percent pebbles; mildly alkaline; clear, wavy boundary.
- B3—7 to 12 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak, coarse, angular blocky structure that parts to weak, fine granules; slightly hard, friable, nonsticky and slightly plastic; 10 percent pebbles; slight effervescence; moderately alkaline; clear, irregular boundary.
- C1ca—12 to 26 inches, white (2.5Y 8/1) silt loam, light gray (2.5Y 7/2) moist; weak, thin, platy structure; slightly hard, friable, nonsticky and nonplastic; 10 percent pebbles; strong effervescence; moderately alkaline; gradual, irregular boundary.
- C2—26 to 60 inches, gray (5Y 6/1) silt loam, olive gray (5Y 4/2) moist; massive; hard, firm, nonsticky and nonplastic; 10 percent pebbles; moderate effervescence; moderately alkaline.

The A1 horizon is loam, gravelly loam, or clay loam in places. The content of gravel throughout the profile ranges from 10 to 15 percent by volume.

Kg—Kiev loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces. It has a profile similar to that described as representative of the series, but the surface layer is loam.

Included with this soil in mapping are a few small areas of soils that have 0 to 2 percent slopes. Also included are small areas of Kiev gravelly loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Kh—Kiev loam, shale substratum, 2 to 4 percent slopes. This gently sloping soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is loam and shale is at a depth of 4 to 5 feet.

Included with this soil in mapping are a few small areas of soils that have 0 to 2 percent slopes. Also included are a few small areas of Reeder soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Kk—Kiev loam, shale substratum, 4 to 8 percent slopes. This moderately sloping soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is loam and shale is at a depth of 4 to 5 feet.

Included with this soil in mapping are a few small areas of soils that have 2 to 4 percent slopes and a few small areas of Reeder and Cabba soils. Also included are small seeps in irrigated areas.

Runoff is medium. The hazard of water erosion and soil blowing are moderate.

This soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IIIe-3, dryland and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Km—Kiev loam, shale substratum, 8 to 15 percent slopes. This moderately steep soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is loam and shale is at a depth of 4 to 5 feet.

Included with this soil in mapping are a few small areas of soils that have slopes of 2 to 8 percent. Also included are a few small seeps in irrigated areas.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IVe-3, dryland, and IVe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Kn—Kiev gravelly loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces.

Included with this soil in mapping, and making up 20 to 30 percent of the area, is a Kiev loam. Also included are small areas of Absher and Crago soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Ko—Kiev gravelly loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces. It has the profile described as representative of the series.

Included with this soil in mapping, and making up 20 to 30 percent of the mapped area, is a Kiev loam. Also included are small areas of Absher and Crago soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Kp—Kiev gravelly loam, 4 to 8 percent slopes. This moderately sloping soil is on dissected fans and terraces.

Included with this soil in mapping, and making up 10 to 20 percent of the mapped area, are Kiev loams that

are underlain by shale at a depth of 4 to 5 feet and a few small areas of Crago soils. Also included are small seeps in irrigated areas.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Kr—Kiev gravelly loam, 8 to 15 percent slopes. This moderately steep soil is on dissected fans and terraces.

Included with this soil in mapping, and making up 10 to 30 percent of the mapped areas, are Kiev loams that are underlain by shale at a depth of 4 to 5 feet and a few small areas of Crago and Cabba soils. Also included are small seeps and saline areas in irrigated fields.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is well suited to dryfarmed and irrigated small grain, hay, pasture, and range. Capability units IVe-3, dryland, and IVe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3L.

Kiwanis Series

The Kiwanis series consists of deep, well-drained soils on terraces and valley bottoms. These soils formed in alluvium. Elevation ranges from 3,400 to 4,600 feet. Slopes are 0 to 2 percent. The native vegetation is mainly needleandthread and prairie sandreed and, in some places, brush and cottonwood. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown fine sandy loam and sandy loam 15 inches thick. The underlying material is grayish-brown sandy loam 21 inches thick over grayish-brown very gravelly sand.

Permeability is moderately rapid to a depth of 36 inches and rapid or very rapid below that depth. Available water capacity is low. Reaction is neutral in the upper 6 inches, mildly alkaline between depths of 6 and 36 inches, and moderately alkaline below a depth of 36 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed and irrigated small grain, tame pasture, and irrigated hay.

Representative profile of Kiwanis fine sandy loam in native grass, 600 feet east and 300 feet north of the southwest corner of sec. 5, T. 31 N., R. 9 W.:

A11—0 to 6 inches, grayish-brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak, fine, granular structure; hard, friable, slightly sticky and slightly plastic; many, fine and coarse roots; neutral; clear, smooth boundary.

A12—6 to 15 inches, grayish-brown (2.5Y 5/2) sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak, medium, angular blocky structure; hard, very friable, nonsticky and nonplastic; many, fine and

- coarse roots; slight effervescence; mildly alkaline; clear, smooth boundary.
- C1—15 to 29 inches, grayish-brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine and few coarse roots; slight effervescence; mildly alkaline; clear, smooth boundary.
- C2—29 to 36 inches, grayish-brown (2.5Y 5/2) sandy loam, very dark grayish brown (2.5Y 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine and few coarse roots; slight effervescence, mildly alkaline; clear, wavy boundary.
- IIC3—36 to 60 inches, grayish-brown (2.5Y 5/2) very gravelly sand, very dark grayish brown (2.5Y 3/2) moist; single grained; loose, nonsticky and nonplastic; few, fine and medium roots; 70 percent pebbles; slight effervescence; lime coatings on some pebbles; moderately alkaline.

The A11 horizon ranges from very dark grayish-brown to grayish-brown. The depth to the IIC3 horizon ranges from 24 to 40 inches. The IIC3 horizon may contain 65 to 80 percent pebbles and a few cobbles.

Ks—Kiwani fine sandy loam (0 to 2 percent slopes). This nearly level soil is on terraces. At times, some areas of this soil are flooded because of winter ice jams of the adjacent streams, spring floods, or upland drainage overflow.

Included with this soil in mapping are a few small areas of Korchea soils. Also included are small areas of shallow, gravelly soils and deep, somewhat poorly drained soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, irrigated hay, and range. Capability units IIIe-4, dryland, and IIIs-1, irrigated; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Korchea Series

The Korchea series consists of deep, well-drained soils on valley bottoms and alluvial terraces and fans. These soils formed in alluvium. Elevation ranges from 3,400 to 4,500 feet. Slopes are 0 to 4 percent. The native vegetation is mainly bluebunch wheatgrass, western and thickspike wheatgrass, and needleandthread, and in some places, cottonwood trees. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown loam 14 inches thick. The underlying material is grayish-brown and light brownish-gray silt loam.

Permeability is moderate. Available water capacity is high. Reaction is mildly alkaline to a depth of 14 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed and irrigated small grain, tame pasture, and irrigated hay.

Representative profile of Korchea loam, 0 to 2 percent slopes, in native range, 1,300 feet south and 1,200 feet east of the northwest corner of sec. 20, T. 31 N., R. 8 W.:

- A11—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark gray (10YR 3/1) moist; weak, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; slight effervescence; mildly alkaline; gradual, wavy boundary.
- A12—7 to 14 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure; slightly hard, very friable, nonsticky and nonplastic; slight effervescence, mildly alkaline; gradual, smooth boundary.
- C1—14 to 24 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline; diffuse, smooth boundary.
- C2—24 to 37 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; some lime in root channels; moderately alkaline; diffuse, smooth boundary.
- C3—37 to 60 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few, medium, distinct, light olive-brown (2.5Y 5/6) or light yellowish-brown (2.5Y 6/4) mottles; strong effervescence; moderately alkaline.

The A1 horizon ranges from fine sandy loam to loam. Below a depth of 50 inches, the texture ranges from silt loam to gravel and sand.

Kt—Korchea loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of poorly drained soils. Also included are small areas of soils that have a surface layer of gravelly loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is mainly suited to dryfarmed and irrigated small grain, tame pasture, hay, and range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Ku—Korchea loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces.

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

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, range, and irrigated hay. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

KV—Korchea and Kiwanis soils (0 to 2 percent slopes). This undifferentiated group of nearly level soils is on valley bottoms.

Included with these soils in mapping are a few small areas of Riverwash and poorly drained soils. Also included are small areas of Gallatin, Novary, and Tinsley soils.

Runoff is slow. The hazards of water erosion and soil blowing are slight or moderate. These soils receive supplemental water from overflow.

These soils are suited to range. Capability unit VIw-1, dryland; Overflow range site, 12- to 14-inch precipi-

tation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Kuro Series

The Kuro series consists of shallow, well-drained soils on dissected uplands. These soils formed in material derived from red shale. Elevation ranges from 4,200 to 4,600 feet. Slopes are 4 to 15 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, and some forbs and shrubs. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is light reddish-brown clay loam 7 inches thick. The underlying material is weak-red and pale-yellow clay loam 8 inches thick over partly weathered shale.

Permeability is slow. Available water capacity is low or very low. Reaction is mildly alkaline to a depth of 7 inches, moderately alkaline between depths of 7 and 15 inches, and strongly alkaline below a depth of 15 inches. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Kuro clay loam in an area of Kuro-Timberg complex, rolling, 600 feet north and 400 feet west of southeast corner of sec. 18, T. 35 N., R. 10 W.:

- Ap—0 to 7 inches, light reddish-brown (5YR 6/3) clay loam, reddish brown (5YR 5/3) moist; weak, very fine, granular structure; slightly hard, friable, sticky and plastic; few, fine roots; slight effervescence; mildly alkaline; clear, wavy boundary.
- C1—7 to 15 inches, weak-red (10R 4/3) and pale-yellow (5Y 7/3) clay loam, dusky red (10R 3/3) and olive (5Y 5/3) moist, colors in very thin horizontal bands; weak, coarse, prismatic structure that parts to strong, thin plates of shale; very hard, firm, sticky and plastic; few, fine roots; slight effervescence; few films of segregated lime; moderately alkaline; gradual, wavy boundary.
- C2—15 to 60 inches, weak-red (10R 4/3) and pale-yellow (5Y 7/3) shale; slight effervescence; strongly alkaline.

The depth to shale ranges from 8 to 20 inches.

Kw—Kuro-Timberg complex, rolling (4 to 15 percent slopes). This complex is on uplands. It is about 60 percent Kuro clay loam and about 30 percent Timberg clay loam. Slopes are mainly 4 to 8 percent. Kuro clay loam is on ridges, hilltops, and south-facing side slopes.

Included with these soils in mapping is 10 percent other soils, mainly Litimber soils in narrow drainage-ways of intermittent streams. Also included are a few small areas of nearly barren shale.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited mainly to range. Capability unit VIs-1, dryland; Kuro part in Shallow range site, 15- to 19-inch precipitation zone, Timberg part in Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; Kuro part in windbreak suitability group 3M, Timberg part in windbreak suitability group 2M.

Leavitt Series

The Leavitt series consists of deep, well-drained soils on hills, ridges, fans, and terraces. These soils formed in glacial till and glacial outwash. Elevation ranges from 4,500 to 6,000 feet. Slopes are 0 to 35 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and some forbs and shrubs. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is very dark gray and very dark grayish-brown loam 7 inches thick. The subsoil is grayish-brown and light brownish-gray clay loam 21 inches thick. The substratum is grayish-brown and light brownish-gray clay loam.

Permeability is moderate. Available water capacity is high. Reaction is neutral to a depth of 20 inches and moderately alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for range. Some areas are used for small grain and tame pasture.

Representative profile of Leavitt loam in an area of Leavitt complex, undulating, in native grass, 1,000 feet north and 800 feet east of the southwest corner of sec. 8, T. 37 N., R. 13 W.:

- A11—0 to 3 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; 5 percent pebbles; neutral; abrupt, smooth boundary.
- A12—3 to 7 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate, medium, angular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 5 percent pebbles; neutral; clear, irregular boundary.
- B2t—7 to 20 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure that parts to moderate, medium angular blocks; hard, friable, sticky and plastic; very dark grayish-brown (10YR 3/2) clay films; 5 percent pebbles; neutral; clear, irregular boundary.
- B3ca—20 to 28 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; hard, friable, sticky and plastic; 10 percent pebbles; slight effervescence; lime in fine threads; moderately alkaline; clear, smooth boundary.
- C1ca—28 to 49 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; 10 percent pebbles; strong effervescence; lime disseminated or segregated; moderately alkaline; gradual, smooth boundary.
- C2—49 to 62 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist, massive; hard, friable, sticky and plastic; 10 percent pebbles; strong effervescence; moderately alkaline.

The A1 horizon is loam or cobbly loam and ranges from 5 to 10 inches in thickness. The combined thickness of the noncalcareous A and B horizons ranges from 16 to 40 inches. The content of rock fragments throughout the profile ranges from 5 to 25 percent, by volume.

La—Leavitt cobbly loam, 0 to 2 percent slopes. This nearly level soil is on glacial outwash terraces. It has a profile similar to that described as representative of the series, but the surface layer contains 15 to 20 percent cobbles and pebbles and a few small stones.

Included with this soil in mapping are small areas of soils that have a few rock fragments in the surface layer.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited mainly to range. Some areas are also suited to tame pasture. Capability unit IVE-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Lb—Leavitt cobbly loam, 2 to 4 percent slopes. This gently sloping soil is on glacial outwash terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer contains 15 to 20 percent cobbles and pebbles and a few small stones.

Included with this soil in mapping are small areas of soils that have a few rock fragments in the surface layer.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited mainly to range. Some areas are also suited to tame pasture. Capability unit IVE-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Lc—Leavitt cobbly loam, 4 to 8 percent slopes. This moderately sloping soil is on glacial outwash terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer contains 15 to 20 percent cobbles and pebbles and a few small stones. Also, the depth to calcareous material ranges from 16 to 32 inches in many areas.

Included with this soil in mapping are small areas of Adel soils in swales and on foot slopes. Small areas of Leavitt loam are also included.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited mainly to range. Some areas are also suited to tame pasture. Capability unit IVE-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Ld—Leavitt cobbly loam, 8 to 15 percent slopes. This moderately steep soil is on remnants of glacial outwash terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer contains 15 to 20 percent cobbles and pebbles and a few small stones. Also the depth to calcareous material ranges from 16 to 32 inches.

Included with this soil in mapping are a few small areas of Adel loam and a few small areas of Leavitt soils that have only a few cobbles and pebbles in the surface layer.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is suited mainly to range. Some areas are also suited to tame pasture. Capability unit IVE-2, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Le—Leavitt complex, undulating (2 to 8 percent slopes). This complex is on hills and ridges. It is about 45 percent Leavitt loam and 35 percent Leavitt cobbly loam. Slopes are mainly 2 to 4 percent. The Leavitt loam in this complex has the profile described as representative of the series. The Leavitt cobbly loam has 15 to 20 percent cobbles and pebbles in the surface layer.

Included with these soils in mapping are about 20 percent other soils, which are equally divided among Adel loam and soils that are similar to Nishon and Leavitt soils, but that have a thin surface layer. Also included are a few small areas of soils that have somewhat greater slopes.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are suited mainly to range. Some areas are also suited to dryfarmed small grain and tame pasture. Capability unit IVE-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

LF—Leavitt complex, hilly (4 to 35 percent slopes). This complex is on hills and ridges. It is about 40 percent Leavitt loam and about 35 percent Leavitt cobbly loam. Slopes are mainly 8 to 15 percent. The soils have a profile similar to that described as representative of the series, but the Leavitt cobbly loam has 15 to 20 percent cobbles and pebbles in the surface layer, the surface layer ranges from 5 to 10 inches in thickness, and the depth to calcareous material ranges from 16 to 32 inches.

Included with these soils in mapping are about 25 percent other soils, equally divided among Adel loam and soils that are similar to Nishon and Leavitt soils but that have a thin surface layer.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited mainly to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Libeg Series

The Libeg series consists of deep, somewhat excessively drained soils on hills, on terraces, and on valley sides along the mountains. These soils formed in glacial deposits of mixed mineralogy. Elevation ranges from 5,000 to 6,500 feet. Slopes are 4 to 60 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and some forbs and shrubs. The mean annual precipitation is 18 to 24 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is very dark grayish-brown stony loam 4 inches thick. The subsoil is brown and reddish-brown gravelly clay loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is low. Reaction is neutral. Organic-matter content is high in the surface layer.

These soils are used mainly for range.

Representative profile of Libeg stony loam in an area of Libeg-Adel complex, rolling, in native grass, 200 feet west and 1,400 feet north of the southeast corner of sec. 33, T. 32 N., R. 12 W.:

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) stony loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; 40 percent pebbles and stones; neutral; clear, irregular boundary.

- B21t—4 to 18 inches, brown (7.5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; moderate, fine, subangular blocky structure that parts to moderate, very fine granules; slightly hard, very friable, sticky and plastic; 70 percent pebbles and stones; common dark brown (7.5YR 4/4) clay films on peds; neutral; gradual, wavy boundary.
- B22t—18 to 38 inches, reddish-brown (5YR 4/4) very gravelly clay loam, dark reddish brown (5YR 3/4) moist; moderate, very fine and fine, subangular blocky structure; hard, friable, sticky and plastic; 60 percent pebbles and stones; common, thin clay films; neutral; clear, wavy boundary.
- B3—38 to 60 inches, brown (7.5YR 5/4) very gravelly clay loam, dark brown (7.5YR 4/4) moist; weak, fine, subangular blocky structure; hard, friable, sticky and plastic; 60 percent pebbles and stones; few, thin crusts of lime on undersides of stones and pebbles; neutral.

The A1 horizon ranges from 4 to 8 inches in thickness. The content of rock fragments throughout the profile ranges from 35 to 75 percent, by volume. In some places, stones and cobbles dominate, and in others the rock fragments are entirely pebbles and cobbles. The B3 horizon is very gravelly clay loam, gravelly loam, or gravelly sandy loam in places. The combined thickness of the A and B horizons ranges from 20 to 60 or more inches, and in some places, there is a horizon of lime accumulation below that depth.

LG—Libeg stony loam, very steep (25 to 60 percent slopes). This soil is on glacial outwash terrace edges, valley sides, and landslide escarpments. Slopes are mainly 35 to 60 percent. It has a profile similar to that described as representative of the series, but the surface layer is not so dark colored and the subsoil is somewhat thinner.

Included with this soil in mapping are a few small areas of nearly barren gravel escarpments and small areas of Adel, Garlet, Mord, and Loberg soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

This soil is suited mainly to range. Capability unit VIIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

LH—Libeg-Adel complex, rolling (4 to 25 percent slopes). This complex is on hills and ridges. It is about 50 percent Libeg stony loam and 40 percent Adel loam. Slopes are mainly 4 to 8 percent. Libeg stony loam is on ridges and hilltops, and Adel loam is mainly on foot slopes and has slopes of 4 to 15 percent. The Libeg soil has the profile described as representative of the Libeg series. The Adel soil has a profile similar to that described as representative of the Adel series. Mean annual precipitation is mainly 20 to 24 inches.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are Mord, Garlet, and Loberg soils. Also included are poorly drained soils in a few small swales and basins.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited mainly to native range. Capability unit VIe-1, dryland; Silty range site, 20- to 24-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Linnet Series

The Linnet series consists of deep, well-drained soils on terraces or on uplands. These soils formed in alluvium or in glacial till. Elevation ranges from 3,700 to 4,300 feet. Slopes are 0 to 8 percent. The native vegetation is mainly green needlegrass, western and thick-spike wheatgrass, and bluebunch wheatgrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 95 to 110 days.

In a representative profile the surface layer is grayish-brown and dark grayish-brown clay 3 inches thick. The subsoil is grayish-brown clay 11 inches thick. The substratum, to a depth of 76 inches, is grayish-brown and dark grayish-brown clay that contains white lime nodules and threads.

Permeability is slow. Available water capacity is moderate or high. Reaction is neutral to a depth of 3 inches, mildly alkaline between depths of 3 and 14 inches, moderately alkaline between depths of 14 and 54 inches, and strongly alkaline below a depth of 54 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed and irrigated small grain, tame pasture, irrigated alfalfa hay, and range.

Representative profile of Linnet clay, 0 to 2 percent slopes, in native grass, 600 feet north of center of sec. 16, T. 31 N., R. 6 W.:

- A11—0 to 1½ inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; strong, very fine, granular structure; slightly hard, friable, sticky and plastic; neutral; abrupt, smooth boundary.
- A12—1½ to 3 inches, dark grayish-brown (10YR 4/2) clay, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure that parts to strong, very fine granules; slightly hard, friable, sticky and plastic; neutral; gradual, irregular boundary.
- B2t—3 to 9 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (10YR 3/2) moist; strong, medium, prismatic structure that parts to strong, very fine subangular blocks; very hard, firm, sticky and plastic; continuous thin clay films on prisms and blocks; mildly alkaline; gradual, irregular boundary.
- B3ca—9 to 14 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; strong, medium, prismatic structure that parts to moderate, medium and fine angular blocks; very hard, firm, sticky and plastic; a few thin clay films on vertical ped surfaces; slight effervescence; mildly alkaline; clear, broken boundary.
- C1ca—14 to 32 inches, grayish-brown (2.5Y 5/2) clay; dark grayish brown (2.5Y 4/2) moist; strong, coarse, prismatic structure that parts to moderate, medium angular blocks; very hard, firm, sticky and plastic; strong effervescence; many, white (N 8/) lime nodules, light gray (2.5Y 7/2) moist; moderately alkaline; gradual, wavy boundary.
- C2ca—32 to 54 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure; very hard, firm, sticky and plastic; between depths of 38 and 42 inches, some slickensides and parallelepipeds; strong effervescence; a few nodules and threads of segregated lime; moderately alkaline; gradual, smooth boundary.
- C3cs—54 to 76 inches, dark grayish-brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; massive; large vertical cracks coated with white

powdery gypsum; common crystals of gypsum in small nests and seams; strong effervescence; strongly alkaline.

Depth to the calcareous material ranges from 8 to 18 inches.

Lk—Linnet clay, 0 to 2 percent slopes. This nearly level soil is on terraces and uplands. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Pendroy and Dimmick soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Available water capacity is high.

This soil is suited to small grain. Where irrigated, it is also suited to hay and pasture. It is well suited to range. Capability units IIIe-3, dryland, and IIIs-2, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Lm—Linnet clay, 2 to 4 percent slopes. This gently sloping soil is on stream terraces and uplands.

Included with this soil in mapping are a few small areas of soils that have slopes of 0 to 2 percent. Also included are small areas of Pendroy, Dimmick, and Vanda soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Available water capacity is high.

This soil is suited to small grain. Where irrigated, it is also suited to hay and pasture. It is well suited to range. Capability units IIIe-3, dryland, and IIIe-2, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Ln—Linnet clay, 4 to 8 percent slopes. This moderately sloping soil is on uplands.

Included with this soil in mapping are a few small areas of soils that have a calcareous surface layer and subsoil. Also included are a few small areas of Pendroy, Dimmick, and Vanda soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Available water capacity is high.

This soil is suited to small grain. It is also suited to range. Where irrigated, it is suited to hay and pasture. Capability units IIIe-3, dryland, and IVe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Lo—Linnet clay, gravelly substratum, 0 to 2 percent slopes. This nearly level soil is on stream terraces. It has a profile similar to that described as representative of the series, but it is underlain by gravelly clay loam between depths of 14 and 42 inches and by gravel and sand below a depth of 42 inches.

Included with this soil in mapping are a few small areas of Absher soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Available water capacity is moderate.

This soil is suited to small grain. Where irrigated, it is also suited to hay and pasture. It is also suited to range. Capability units IIIe-4, dryland, and IIIs-2, irrigated; Clayey range site, 12- to 14-inch precipitation

zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Lp—Linnet clay, gravelly substratum, 2 to 4 percent slopes. This gently sloping soil is on stream terraces. It has a profile similar to that described as representative of the series, but it is underlain by gravelly clay loam between depths of 14 and 42 inches and by gravel and sand below a depth of 42 inches.

Included with this soil in mapping are a few small areas of Absher soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate. Available water capacity is moderate.

This soil is suited to small grain. Where irrigated, it is also suited to hay and pasture. It is also suited to range. Capability units IIIe-3, dryland, and IIIe-2, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Litimber Series

The Litimber series consists of deep, well-drained soils on terraces and alluvial fans. These soils formed in alluvium primarily derived from red shale. Elevation ranges from 4,200 to 4,600 feet. Slopes are 2 to 8 percent. The native vegetation is mainly Columbia and green needlegrasses, western and thickspike wheatgrasses, rough fescue, and some forbs and shrubs. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the upper part of the surface layer is dark grayish-brown loam 2 inches thick, and the lower part is reddish-brown clay loam 2 inches thick. The subsoil is reddish-brown clay loam 13 inches thick. The upper part of the substratum is pink clay loam 23 inches thick, and the lower part is light reddish-brown clay loam to a depth of 66 inches.

Permeability is moderate. Available water capacity is high. Reaction is neutral to a depth of 4 inches, mildly alkaline between depths of 4 and 9 inches, and moderately alkaline below a depth of 9 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed small grain, pasture, and range.

Representative profile of Litimber clay loam, 2 to 4 percent slopes, in native grass, 700 feet north and 800 feet west of the southeast corner of sec. 8, T. 35 N., R. 10 W.:

- A11—0 to 2 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; many, very fine roots; neutral; abrupt, irregular boundary.
- A12—2 to 4 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; weak, fine, subangular blocky and moderate, very fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; few, fine, tubular pores and many, fine, interstitial pores; many, very fine roots; neutral; clear, broken boundary.
- B21—4 to 9 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium, prismatic structure that parts to moderate, medium and fine angular blocks; hard, friable, sticky and plastic; many, fine and very fine, vertical and horizontal, tubular pores; many,

very fine roots; mildly alkaline; clear, irregular boundary.

B22—9 to 17 inches, reddish-brown (5YR 5/3) heavy clay loam, reddish brown (5YR 4/4) moist; moderate, medium, prismatic structure; hard, friable, sticky and plastic; many, fine and medium, vertical, tubular pores; common, very fine roots; slight effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—17 to 40 inches, pink (5YR 7/3) heavy clay loam, reddish brown (5YR 5/3) moist; weak, coarse, prismatic structure that parts to weak, medium plates; hard, friable, slightly sticky and slightly plastic; common, fine, vertical, tubular pores; common, very fine roots; strong effervescence; many films and threads of soft, segregated lime; moderately alkaline; gradual, wavy boundary.

C2—40 to 66 inches, light reddish-brown (5YR 6/3) light clay loam, reddish brown (5YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; slight effervescence; less than 5 percent films of segregated lime; moderately alkaline.

The A1 horizon ranges from 3 to 7 inches in thickness and is clay loam, loam, or cobbly clay loam. The A horizon is 0 to 25 percent cobbles. The B2 horizon ranges from 9 to 23 inches in thickness. The depth to carbonates is 7 to 15 inches and the depth to the C1ca horizon is 12 to 30 inches.

Lr—Litimber clay loam, 2 to 4 percent slopes. This gently sloping soil is on terraces and alluvial fans in the red shale uplands. It has the profile described as representative of the series.

Included with this soil in mapping are a few small, wet, saline areas and small areas of Rhoades soils.

Runoff is medium or slow. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed wheat and barley. It is also well suited to pasture and range. Capability unit IIIe-2, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Ls—Litimber clay loam, 4 to 8 percent slopes. This moderately sloping soil is on alluvial fans adjacent to and on the red shale uplands.

Included with this soil in mapping are some small, wet, saline areas and small areas of Rhoades, Timberg, and Kuro soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed wheat and barley. It is also well suited to pasture and range. Capability unit IIIe-2, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Lt—Litimber cobbly clay loam, undulating (2 to 8 percent slopes). This soil is on terraces and alluvial fans bordering red shale uplands. Slopes are short and complex and are mainly 2 to 4 percent. It has a profile similar to that described as representative of the series, but the surface layer is cobbly clay loam that is 15 to 25 percent cobbles.

Included with this soil in mapping are a few small areas of soils, in swales and drainageways, that have a loam surface layer. Small areas of Rhoades, Kuro, and Timberg soils are also included.

Runoff is medium or slow. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed wheat and barley. It

is also well suited to pasture and range. Capability unit IIIe-2, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Lu—Litimber complex, 2 to 8 percent slopes. This complex of gently sloping and moderately sloping soils is on terraces and alluvial fans adjacent to and within the red shale uplands. This complex is about 60 percent Litimber clay loam and 20 percent Litimber loam.

Included with these soils in mapping are 15 percent Rhoades soils and 5 percent Timberg soils.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

Litimber soils are suited to dryfarmed wheat and barley. They are also suited to pasture and range. Capability unit IIIe-2, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Loberg Series

The Loberg series consists of deep, well-drained soils on foot slopes of mountains, sides of ridges, in valleys in the mountains, and on glacial till uplands adjacent to the mountains. These soils formed in glacial till under forest vegetation. Elevation ranges from 5,000 to 6,500 feet. Slopes are 4 to 45 percent. The native vegetation is mainly lodgepole pine, spruce, and aspen and an understory of pinegrass, oregongrape, and snowberry. The mean annual precipitation is 20 to 35 inches, the mean annual air temperature is 34° to 38° F, and the growing season is 60 to 90 days.

In a representative profile a mat of fresh and decomposed twigs, leaves, and needles about 4 inches thick overlies the surface layer. The surface layer is light-gray stony loam 6 inches thick. The subsoil is brown, yellowish-brown, and grayish-brown cobbly heavy clay loam 47 inches thick. The substratum is light-gray very cobbly light clay loam.

Permeability is slow. Available water capacity is moderate. Reaction is slightly acid to a depth of 15 inches, neutral between depths of 15 and 33 inches, and mildly alkaline below a depth of 53 inches. Organic-matter content is low in the surface layer.

These soils are used mainly for woodland and grazeable woodland.

Representative profile of Loberg stony loam in an area of Loberg soils, hilly, in woodland, 200 feet west and 1,900 feet north of southeast corner of sec. 15, T. 34 N., R. 14 W.:

- O1—4 to 2 inches, fresh needles, leaves, and twigs.
- O2—2 inches to 0, compacted decomposing organic material; slightly acid.
- A21—0 to 3 inches, light-gray (10YR 7/2) stony loam, grayish brown (10YR 5/2) moist; moderate, thin, platy structure; soft, friable, nonsticky and nonplastic; stones 1 to 3 feet in diameter make up less than 1 percent of the surface; many roots; slightly acid; clear, wavy boundary.
- A22—3 to 6 inches, light-gray (10YR 7/2) stony loam, brown (10YR 5/3) moist; moderate, thick, platy structure that parts to weak, medium angular blocks; slightly hard, friable, slightly sticky and slightly plastic; very pale brown (10YR 7/3) coatings on peds; 30 percent rock fragments; common roots; slightly acid; clear, wavy boundary.
- B21t—6 to 15 inches, brown (10YR 5/3) cobbly heavy clay

- loam, dark yellowish brown (10YR 4/4) moist; strong, fine, angular blocky structure; hard, firm, sticky and plastic; common, dark-brown (10YR 4/3) moist clay films on peds; 30 percent cobbles; many roots; slightly acid; clear, wavy boundary.
- B22t—15 to 28 inches, yellowish-brown (10YR 5/4) cobbly heavy clay loam, olive brown (2.5Y 4/4) moist; moderate, medium, angular blocky structure; hard, firm, slightly sticky and slightly plastic; many roots; very dark grayish-brown (2.5Y 3/2), moist clay films on peds; 40 percent cobbles and gravel; neutral; clear, wavy boundary.
- B23—28 to 53 inches, grayish-brown (10YR 5/2) very cobbly heavy clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, fine, angular blocky structure; hard, firm, slightly sticky and slightly plastic; many roots; 60 percent cobbles and gravel; neutral; clear, wavy boundary.
- C—53 to 60 inches, light-gray (5Y 7/2) very cobbly light clay loam, olive (5Y 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few roots; 50 percent cobbles and gravel; slight effervescence; mildly alkaline.

The O horizon ranges from 1½ to 5 inches in thickness. The A2 horizon ranges from 2 to 8 inches in thickness. The B2 horizon ranges from cobbly heavy clay loam to cobbly or very cobbly light clay. The depth to lime ranges from 40 to more than 60 inches. The content of rock fragments ranges from 30 to 60 percent, by volume.

LV—Loberg-Mord association, hilly (4 to 35 percent slopes). This association is on uplands. It is about 50 percent Loberg stony loam and 40 percent Mord stony loam. Slopes are mainly 8 to 15 percent. The Loberg soil is mainly on north- and east-facing side slopes, and the Mord soil is mainly on south- and east-facing side slopes.

Included with these soils in mapping are some small wet areas. Also included, and making up about 10 percent of the mapped area, are Adel, Bridger, Libeg, and Swifton soils.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

Loberg soils are suited to woodland and grazeable woodland. Mord soils are suited to range. Capability unit VIe-1, dryland; Loberg part not assigned to a range site, Mord part in Silty range site, 20- to 24-inch precipitation zone; Loberg part in woodland suitability group 5o1, Mord part not assigned to a woodland suitability group; windbreak suitability group 4.

LW—Loberg-Whitore association, very steep (15 to 60 percent slopes). This association is on sides of valleys, sides of ridges, and foot slopes of mountains. It is about 50 percent Loberg stony loam and 30 percent Whitore stony loam. Slopes are mainly 35 to 60 percent. The Loberg soil has slopes of 15 to 45 percent, and the Whitore soil has slopes of 35 to 60 percent. The Loberg soil has a profile similar to that described as representative of the Loberg series. The Whitore soil has a profile similar to that described as representative of the Whitore series, but the depth to calcareous material is 15 to 18 inches and the surface layer is stony.

Included with these soils in mapping, and making up about 20 percent of the mapped area, are Garlet, Libeg, Mord, and Swifton soils.

Runoff is medium or rapid. The hazards of water erosion and soil blowing are slight or moderate.

The soils in this association are suited mainly to woodland. They are also suited to grazeable woodland. Loberg part in capability unit VIe-1, dryland, Whitore

part in capability unit VIIe-1, dryland; not assigned to a range site; Loberg part in woodland suitability group 5r1, Whitore part in woodland suitability group 7f2; windbreak suitability group 4.

LY—Loberg soils, hilly (4 to 35 percent slopes). This undifferentiated group is on glacial moraines on uplands and on sides of valleys in the mountains. It consists of Loberg stony loam and Loberg loam. Slopes are mainly 8 to 15 percent. The Loberg stony loam has the profile described as representative of the series.

Included with these soils in mapping along Badger Creek are some areas of soils that have a higher percentage of limestone fragments and in which lime is at a depth of 36 to 60 inches. Also included in mapping are small areas of Mord, Swifton, and Whitore soils and small lakes and wet areas.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

These soils are mostly suited to woodland. They are also suited to grazeable woodland. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 5o1; windbreak suitability group 4.

Martinsdale Series

The Martinsdale series consists of deep, well-drained soils on terraces and fans. These soils formed in alluvium. Elevation ranges from 3,800 to 4,500 feet. Slopes are 0 to 15 percent. The native vegetation is mainly green needlegrass, western and thickspike wheatgrass, bluebunch wheatgrass, and some forbs and shrubs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown gravelly clay loam 6 inches thick. The subsoil is dark grayish-brown and light-gray gravelly clay loam 18 inches thick. The upper part of the substratum is light-gray gravelly clay loam 14 inches thick, and the lower part is white and very pale brown gravelly sandy clay loam 30 inches thick.

Permeability is moderate. Available water capacity is high. Reaction is neutral to a depth of 15 inches, mildly alkaline between depths of 15 and 24 inches, and moderately alkaline below a depth of 24 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed crops, pasture, and range. Some areas are used for irrigated crops, pasture, and hay.

Representative profile of Martinsdale gravelly clay loam, 0 to 2 percent slopes, in a cultivated field, 50 feet west and 25 feet north of the southeast corner of sec. 36, T. 33 N., R. 7 W.:

- Ap—0 to 6 inches, grayish-brown (10YR 5/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; strong, medium and fine, granular structure; hard, friable, sticky and plastic; common roots; 15 percent pebbles; neutral; clear, smooth boundary.
- B2t—6 to 15 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure that parts to moderate, medium and fine angular blocks; hard, firm, sticky and plastic; common roots; very dark grayish-brown (10YR 3/2), moist, clay films on

pedes; 15 percent pebbles; neutral; clear, wavy boundary.

B3ca—15 to 24 inches, light-gray (2.5Y 7/2) gravelly clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; hard, firm, sticky and plastic; a few masses of lime; common roots; 15 percent pebbles; strong effervescence; mildly alkaline; clear, wavy boundary.

C1ca—24 to 38 inches, light-gray (2.5Y 7/2) gravelly clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; hard, firm, sticky and plastic; few roots; 15 percent pebbles; strong effervescence; moderately alkaline; clear, wavy boundary.

C2ca—38 to 58 inches, white and light-gray (10YR 8/2 and 7/2) gravelly sandy clay loam, pale brown and very pale brown (10YR 6/3 and 7/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few roots; 15 percent pebbles; strong effervescence; moderately alkaline; clear, wavy boundary.

C3ca—58 to 68 inches, very pale brown (10YR 7/3) gravelly sandy clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; no roots; 25 percent pebbles; strong effervescence; moderately alkaline.

The Ap horizon is loam, clay loam, gravelly loam, or gravelly clay loam in places. The content of pebbles in the upper 38 inches ranges from 10 to 20 percent, by volume, and below a depth of 38 inches it ranges from 15 to 35 percent.

Ma—Martinsdale loam, 0 to 2 percent slopes. This nearly level soil is on terraces.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mb—Martinsdale loam, 2 to 4 percent slopes. This gently sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is loam.

Included with this soil in mapping are a few small areas of a Martinsdale gravelly loam. Also included are small areas of soils that have slopes of 0 to 2 percent.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mc—Martinsdale loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer is loam and in most areas sandstone or shale is at a depth of 4 to 6 feet.

Included with this soil in mapping are a few small areas of soils that have somewhat greater slopes. Also included are small areas of Martinsdale gravelly loam on narrow ridgetops and Arnegard loam in concave areas.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch

precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Md—Martinsdale gravelly loam, 2 to 4 percent slopes. This gently sloping soil is on terraces.

Included with this soil in mapping are a few small areas of soils that have slopes of 0 to 2 percent. Also included are small areas of a Martinsdale loam.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Me—Martinsdale clay loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is clay loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mf—Martinsdale clay loam, 2 to 4 percent slopes. This gently sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is clay loam.

Included with this soil in mapping are a few small areas of Absher soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mg—Martinsdale clay loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and in most areas shale is at a depth of 4 to 6 feet.

Included with this soil in mapping are a few small areas of Arnegard soils and of a Martinsdale gravelly clay loam. Also included are small areas of soils that have somewhat greater slopes.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mh—Martinsdale clay loam, 8 to 15 percent slopes. This moderately steep soil is on terraces and fans. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and in most areas shale is at a depth of 4 to 6 feet.

Included with this soil in mapping are a few small areas of Wayden soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain and tame

pasture. It is also suited to range. Capability unit IVE-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mk—Martinsdale gravelly clay loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Martinsdale clay loam. Also included are small areas of soils that have a cobbly surface layer.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mm—Martinsdale gravelly clay loam, 2 to 4 percent slopes. This gently sloping soil is on terraces.

Included with this soil in mapping are a few small areas of soils that have a cobbly surface layer and of soils that have a clay loam surface layer. Small areas of soils that have slopes of 0 to 2 percent are also included.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mn—Martinsdale gravelly clay loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces and fans. It has a profile similar to that described as representative of the series, but shale is at a depth of 4 to 6 feet in most areas.

Included with this soil in mapping are a few small areas of Arnegard soils and small areas of a Martinsdale clay loam. Small areas of soils that have somewhat greater slopes are also included.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-3, dryland, and IIIe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Michelson Series

The Michelson series consists of deep, well-drained soils on high terraces. These soils formed in alluvium. Elevation ranges from 4,400 to 5,400 feet. Slopes are 0 to 15 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and Columbia and green needlegrass. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 95 days.

In a representative profile the surface layer is very dark grayish-brown cobbly loam 5 inches thick. The subsoil is yellowish-brown clay loam 13 inches thick.

The substratum is pink clay loam 20 inches thick over a buried subsoil of light-brown and reddish-yellow sandy clay loam and sandy clay.

Permeability is moderate. Available water capacity is high. Reaction is neutral or slightly acid to a depth of 18 inches and mildly alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for range. Some areas are used for small grain and tame pasture.

Representative profile of Michelson cobbly loam, 0 to 2 percent slopes, in native grass, 1,600 feet west and 500 feet north of the center of sec. 2, T. 34 N., R. 12 W.:

- A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) cobbly loam, black (10YR 2/1) moist; weak, coarse, prismatic structure that parts to weak, fine granules; slightly hard, very friable, nonsticky and slightly plastic; many, fine and very fine roots; 35 percent rounded cobbles and pebbles; neutral; clear, irregular boundary.
- B21t—5 to 13 inches, yellowish-brown (10YR 5/4) clay loam, dark brown (10YR 3/3) moist; strong, medium, prismatic structure that parts to moderate, medium, angular blocks; hard, friable, slightly sticky and slightly plastic; common, fine and very fine roots, concentration of roots between prisms; common, thick, very dark grayish-brown (10YR 3/2) coatings on prisms; common, thin clay films on blocky peds; 10 percent rounded pebbles and cobbles; slightly acid; clear, wavy boundary.
- B22t—13 to 18 inches, yellowish-brown (10YR 5/4) clay loam, brown (10YR 4/3) moist; strong, medium, prismatic structure that parts to moderate, medium angular blocks; hard, friable, slightly sticky and slightly plastic; common, fine and very fine roots, concentration of roots between prisms; common, moderately thick, very dark grayish-brown (10YR 3/2) coatings on prisms; common, thin clay films on blocky peds; 10 percent rounded pebbles and cobbles; neutral; clear, wavy boundary.
- C1ca—18 to 34 inches, pink (5YR 8/3) clay loam, reddish brown (2.5YR 4/4) moist; weak, thin, platy structure; hard, friable, slightly sticky and plastic; few, medium and fine roots; 10 percent rounded pebbles and cobbles; strong effervescence; segregated lime as seams and as coatings on pebbles and cobbles; mildly alkaline; clear, wavy boundary.
- C2ca—34 to 38 inches, pink (5YR 7/4 and 8/4) clay loam, reddish yellow (5YR 6/6) moist; massive; hard, friable, sticky and plastic; few, fine roots; 15 percent rounded pebbles and cobbles; strong effervescence; segregated lime as seams; mildly alkaline; clear, wavy boundary.
- IIB21bca—38 to 48 inches, light-brown (7.5YR 6/4) very gravelly sandy clay loam, yellowish red (5YR 5/6) moist; massive; very hard, firm, very sticky and plastic; few, fine roots; 70 percent rounded pebbles and cobbles; strong effervescence; lime coatings on pebbles and cobbles, mostly on bottom sides; mildly alkaline; clear, wavy boundary.
- IIB22tbca—48 to 72 inches, reddish-yellow (5YR 6/6) very gravelly sandy clay, yellowish red (5YR 4/6) moist; massive; very hard, firm, sticky and plastic; 70 percent rounded pebbles and cobbles; distinct clay films in tubular pores and coating some pebbles and bridging sand; segregated lime coating on some pebbles and cobbles; mildly alkaline.

Depth to calcareous material ranges from 16 to 26 inches. To a depth of 38 inches, content of rock fragments ranges from 10 to 50 percent, by volume, and below this depth it ranges from 55 to 70 percent.

Mo—Michelson loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer has only a few pebbles or cobbles.

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

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IVE-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mp—Michelson loam, 2 to 4 percent slopes. This gently sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer has only a few pebbles or cobbles.

Included with this soil in mapping are a few small areas of soils that have a gravelly or cobbly surface layer.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IVE-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mr—Michelson loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer has only a few pebbles or cobbles and shale is at a depth of 4 to 6 feet in most areas.

Included with this soil in mapping are a few small areas of soils that have a gravelly or cobbly surface layer. Also included are a few small areas of Fifer and Bynum soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IVE-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Ms—Michelson loam, 8 to 15 percent slopes. This moderately steep soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer has only a few pebbles or cobbles and shale is at a depth of 4 to 6 feet in most areas.

Included with this soil in mapping are a few small areas of seeps. Also included are small areas of Pishkun and Adel soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is suited to range. It is also suited to tame pasture and small grain. Capability unit IVE-3, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mt—Michelson cobbly loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have only a few pebbles or cobbles in the surface layer.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IVE-4, dryland; Silty range site,

15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mu—Michelson cobbly loam, 2 to 4 percent slopes. This gently sloping soil is on terraces.

Included with this soil in mapping are a few small areas of soils that have only a few pebbles or cobbles in the surface layer.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IVE-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mv—Michelson cobbly loam, 4 to 8 percent slopes. This moderately sloping soil is on terraces. It has a profile similar to that described as representative of the series, but shale is at a depth of 4 to 6 feet in most areas.

Included with this soil in mapping are a few small areas of soils that have only a few pebbles or cobbles in the surface layer. Also included are small areas of seeps. Small areas of Adel soils in drainageways and at the base of slopes are also included.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to range, small grain, and pasture. Capability unit IVE-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mw—Michelson cobbly loam, 8 to 15 percent slopes. This moderately steep soil is on terraces. It has a profile similar to that described as representative of the series, but shale is at a depth of 4 to 6 feet in most areas.

Included with this soil in mapping are a few small areas of soils that have only a few pebbles or cobbles in the surface layer. Also included are small areas of seeps and small areas of Pishkun, Adel, Bynum, and Fifer soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

This soil is suited to range. It is also suited to small grain and tame pasture. Capability unit IVE-2, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mx—Michelson stony loam, 0 to 4 percent slopes. This nearly level or gently sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is stony.

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

Runoff is slow or medium. The hazards of water erosion and soil blowing are slight or moderate.

This soil is suited to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2L.

Mikesell Series

The Mikesell series consists of deep, well-drained soils on hills and foot slopes on uplands. These soils

formed in glacial till or shale. Elevation ranges from 4,600 to 6,000 feet. Slopes are 4 to 35 percent. The native vegetation is mainly Engelmann spruce, lodgepole pine, Douglas-fir, and aspen and a thick understory of shrubs, forbs, and grasses. The mean annual precipitation is 20 to 30 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 90 days.

In a representative profile a 3-inch-thick layer of decomposed and undecomposed leaves and twigs is on the surface. The surface layer is light-gray clay loam 6 inches thick. The next layer is light brownish-gray clay loam 6 inches thick. The subsoil is light brownish-gray and light-gray heavy clay loam, light clay, and clay loam 39 inches thick. The substratum is dark-gray silty clay loam.

Permeability is moderately slow. Available water capacity is high. Reaction is neutral to a depth of 29 inches and mildly alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for woodland and grazeable woodland.

Representative profile of Mikesell clay loam, hilly, in woodland, 1,800 feet north and 100 feet west of the southeast corner of sec. 4, T. 35 N., R. 14 W.:

- O1—3 to 2 inches, undecomposed leaves and twigs.
- O2—2 inches to 0, decomposed organic material, black (10YR 2/1) moist; neutral.
- A2—0 to 6 inches, light-gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; moderate, thin, platy structure in the upper part and moderate, medium, angular blocky structure in the lower part; soft, very friable, slightly sticky and slightly plastic; neutral; clear, irregular boundary.
- A&B—6 to 12 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, angular blocky structure; light gray (10YR 7/2) and gray (10YR 6/1), moist, coats on peds; slightly hard, firm, sticky and plastic; neutral; clear, irregular boundary.
- B&A—12 to 21 inches, light brownish-gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure that parts to strong, medium angular blocks; primary peds coated with light gray (10YR 7/2) and gray (10YR 6/1) moist; hard, very firm, sticky and plastic; neutral; clear, irregular boundary.
- B2t—21 to 29 inches, light brownish-gray (2.5Y 6/2) light clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium, angular blocky structure; hard, firm, sticky and plastic; many peds have prominent, very dark grayish-brown (10YR 3/2) when moist, clay-organic films; common roots; neutral; clear, wavy boundary.
- B3ca—29 to 51 inches, light-gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; peds coated with very dark grayish brown (10YR 3/2), moist and dry; slightly hard, friable, slightly sticky and slightly plastic; few, fine roots; strong effervescence in spots; mildly alkaline; clear, wavy boundary.
- Cca—51 to 80 inches, dark gray (N 8/) silty clay loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; strong effervescence; mildly alkaline.

In places a few cobbles, stones, or pebbles are in the upper part of the profile. In some places the depth to shale ranges from 4 to 7 feet.

My—Mikesell clay loam, hilly (4 to 35 percent slopes). This soil is on hills and foot slopes of the mountains. Slopes are mainly 8 to 15 percent.

Included with this soil in mapping are a few small

areas of Nettleton soils. Also included are small areas of seeps, small areas of barren shale slip scars, and small areas of soils that have somewhat greater slopes.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

This soil is suited to woodland and grazeable woodland. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 5c1; windbreak suitability group 4.

Mixed Alluvial Land

MZb—Mixed alluvial land (0 to 2 percent slopes). This land type consists of recent alluvium along major streams. Most areas are 20 to 100 acres in size, but there are some areas of several hundred acres. The soils vary greatly in depth to gravel and sand, in texture, and in drainage.

Areas of these soils are frequently flooded. High water in spring usually saturates the soil either by flooding or by raising the water table.

This land type is used mainly for range. Cottonwood trees are common in most areas of these soils. Capability unit VIw-1, dryland; Overflow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Mord Series

The Mord series consists of deep, well-drained soils on mountains, uplands, and upland foot slopes. These soils formed in glacial till. Elevation ranges from 4,800 to 6,000 feet. Slopes are 4 to 35 percent. The native vegetation is mainly rough fescue, Richardson and Columbia needlegrass, mountain brome, Parry danthonia, perennial forbs, woody plants, and in some places, aspen and lodgepole pine. The mean annual precipitation is 18 to 30 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is dark-gray stony loam 7 inches thick. The next 9 inches is grayish-brown loam. The next layer is pale-brown clay loam 5 inches thick. The subsoil is brown silty clay to a depth of 60 inches.

Permeability is slow. Available water capacity is high. Reaction is neutral to a depth of 21 inches and mildly alkaline below that depth. Organic-matter content is high in the surface layer.

These soils are used mainly for range and tame pasture. Some areas are used for woodland and grazeable woodland.

Representative profile of Mord stony loam, steep, in native grass, 1,000 feet north and 200 feet east of the center of sec. 22, T. 32 N., R. 13 W.:

- A1—0 to 7 inches, dark-gray (10YR 4/1) stony loam, black (10YR 2/1) moist; moderate, very fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many, fine vesicles; many, clear sand grains; 20 percent stones, cobbles, and pebbles; neutral; clear, wavy boundary.
- A2—7 to 16 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure; hard, very friable, slightly sticky and nonplastic; common pores, with clear silt and sand grains; 10 percent pebbles; neutral; abrupt, wavy boundary.

B&A—16 to 21 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 3/3) moist; weak, very coarse, prismatic structure; hard, friable, sticky and plastic; common, fine pores with a few clay films and clear silt grains; 15 percent pebbles; neutral; gradual, wavy boundary.

B21t—21 to 28 inches, brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; strong, medium and fine, subangular blocky structure; very hard, firm, sticky and plastic; common, thin clay films on peds; clear silt grains in pores; 10 percent pebbles; mildly alkaline; clear, wavy boundary.

B22t—28 to 60 inches, brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; strong, medium and fine, subangular blocky structure; very hard, firm, very sticky and very plastic; common, fine pores with silt grains; common thin clay films on peds; 10 percent pebbles; mildly alkaline.

The A1 horizon is loam or stony loam and ranges from 6 to 12 inches in thickness. The A2 horizon ranges from 2 to 10 inches in thickness. In places, there is a Cca horizon and the soil is calcareous below a depth of 40 inches. The content of rock fragments ranges from 10 to 25 percent, by volume, throughout.

Mz—Mord loam, sloping (4 to 8 percent slopes).

This soil is on foot slopes and fans in the uplands. It has a profile similar to that described as representative of the series, but the surface layer has few rock fragments.

Included with this soil in mapping are a few small areas of soils that have stones in the surface layer.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to range and tame pasture. Capability unit IVe-2, dryland; Silty range site, 20- to 24-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

MZc—Mord stony loam, steep (8 to 35 percent slopes). This soil is on uplands and mountains. It has the profile described as representative of the series. Slopes are mainly 15 to 35 percent.

Included with this soil in mapping are a few small areas of Adel soil in concave areas. Also included are Libeg soils on ridges and knolls and small areas of poorly drained soils in closed basins.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

This soil is suited to range. Capability unit VIe-1, dryland; Silty range site, 20- to 24-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Nettleton Series

The Nettleton series consists of deep, moderately well drained soils on hills, on foot slopes, and in swales on uplands and mountains. These soils formed in glacial till and till over materials weathered from shale. Elevation ranges from 4,600 to 6,000 feet. Slopes are 2 to 35 percent. The native vegetation is mainly rough fescue, Richardson and Columbia needlegrass, perennial forbs, and in some places, aspen. The mean annual precipitation is 18 to 30 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 90 days.

In a representative profile the surface layer is gray and dark-gray clay loam 19 inches thick. The next layer is light-gray clay 2 inches thick. The subsoil is

gray clay 13 inches thick. The substratum is light-gray clay 16 inches thick over light-gray shale.

Permeability is slow. Available water capacity is high. Reaction is neutral to a depth of 26 inches, mildly alkaline between depths of 26 and 34 inches, and moderately alkaline below a depth of 34 inches. Organic-matter content is high in the surface layer.

These soils are used mainly for range and woodland.

Representative profile of Nettleton clay loam in an area of Nettleton and Mikesell clay loams, hilly, 500 feet east and 1,300 feet south of the center of sec. 8, T. 37 N., R. 15 W.:

A11—0 to 3 inches, gray (10YR 5/1) clay loam, very dark brown (10YR 2/2) moist; moderate, fine and very fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear, wavy boundary.

A12—3 to 14 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; strong, fine and very fine, granular structure; slightly hard, very friable, sticky and slightly plastic; neutral; clear, wavy boundary.

A13—14 to 19 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; strong, fine, granular structure; slightly hard, very friable, sticky and plastic; neutral; abrupt, wavy boundary.

IIA&B—19 to 21 inches, light-gray (10YR 7/1) clay, gray (N 5/) moist; strong, very fine, subangular blocky structure; hard, firm, sticky and plastic; neutral; abrupt, wavy boundary.

IIB21t—21 to 26 inches, gray (N 5/ and N 6/) clay, very dark gray (N 3/ and 4/) moist; moderate, medium, prismatic structure that parts to strong, medium, subangular blocks; extremely hard, firm, sticky and very plastic; continuous, thin clay films on peds; neutral; clear, wavy boundary.

IIB22t—26 to 34 inches, gray (N 6/) clay, very dark gray (N 3/) moist; many, medium, distinct, light yellowish-brown (2.5Y 6/4) and light olive-brown (2.5Y 5/4) mottles; weak, medium, prismatic structure that parts to moderate, medium subangular blocks; extremely hard, firm, sticky and very plastic; continuous thin clay films on peds; mildly alkaline; gradual, wavy boundary.

IIC1—34 to 50 inches, light-gray (N 7/) clay, dark gray (N 4/) moist; massive; extremely hard, firm, sticky and very plastic; strong effervescence; moderately alkaline; gradual, wavy boundary.

IIC2—50 to 66 inches, light-gray (N 7/) shale, very dark gray (N 3/) moist; strong effervescence; lime in the seams of shale; moderately alkaline.

The A1 horizon is loam or clay loam and ranges from 10 to 20 inches in thickness. In places, there are a few cobbles and stones. In some places, shale does not occur within a depth of 60 inches.

In this survey area, soils in the Nettleton series lack an A2 horizon and are somewhat better drained than is typical for the series. These differences, however, do not affect the use and management of the soils.

NB—Nettleton-Burnett association, undulating (2 to 8 percent slopes). This association is on uplands. It is about 60 percent Nettleton loam and 40 percent Burnette loam. Slopes are mainly 2 to 4 percent. Nettleton loam is in swales and on foot slopes, and Burnette loam is on broad ridges. The Nettleton soil has a profile similar to that described as representative of the Nettleton series, but the surface layer is loam. The Burnette soil has a profile similar to that described as representative of the Burnette series.

Included with these soils in mapping are a few small wet areas.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

These soils are suited mainly to range. Capability unit IVE-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

NM—Nettleton and Mikesell clay loams, hilly (4 to 35 percent slopes). This undifferentiated group is on hills and foot slopes of mountains. This group is about 50 percent Nettleton clay loam and 50 percent Mikesell clay loam. Slopes are mainly 8 to 15 percent. In a few areas of this unit one of the soils dominates, but most areas include both soils. The Nettleton soil has the profile described as representative of the Nettleton series. The Mikesell soil has a profile similar to that described as representative of the Mikesell series.

Included with these soils in mapping are a few small areas of shale outcrop. Also included are a few small wet areas.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

These soils are suited mainly to woodland and grazable woodland. Vegetation on the Nettleton soil is aspen and on the Mikesell soil is spruce or lodgepole pine. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 5c1; windbreak suitability group 4.

Nishon Series

The Nishon series consists of deep, poorly drained or somewhat poorly drained soils in depressions and swales on uplands. These soils formed in alluvium. Elevation ranges from 3,800 to 4,500 feet. Slopes are 0 to 2 percent. The native vegetation is mainly western and thickspike wheatgrass, basin wildrye, green needlegrass, and some forbs and woody plants. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 85 to 110 days.

In a representative profile the surface layer is light brownish-gray light clay loam 7 inches thick. The subsoil is dark-gray and gray clay 35 inches thick. The substratum is olive-gray and olive clay to a depth of 60 inches.

Permeability is slow. Available water capacity is high. Reaction is neutral to a depth of 7 inches, mildly alkaline between depths of 7 and 9 inches, moderately alkaline between depths of 9 and 22 inches, and strongly alkaline below a depth of 22 inches. Organic-matter content is low in the surface layer.

These soils are used mainly for small grain, tame pasture, and range.

Representative profile of Nishon clay loam, in a cultivated field, 2,200 feet north and 100 feet east of the southwest corner of sec. 32, T. 35 N., R. 5 W.:

Ap—0 to 7 inches, light brownish-gray (10YR 6/2) clay loam, dark gray (10YR 4/1) moist; weak, thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; many, very fine roots; many, fine, tubular pores; neutral; abrupt, smooth boundary.

B21t—7 to 19 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, fine, columnar structure that parts to moderate, medium and fine angular blocks; very hard, very firm, very sticky and very plastic; common, gray silt grains and

clay films on peds; mildly alkaline; clear, smooth boundary.

B22t—19 to 22 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; moderate, medium, prismatic structure that parts to moderate, medium angular blocks; very hard, very firm, very sticky and very plastic; common, very fine roots, most roots between prisms; few, tubular pores; many, thin clay films on peds; moderately alkaline; clear, smooth boundary.

B3ca—22 to 42 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; weak, coarse, prismatic structure that parts to weak, medium subangular blocks; extremely hard, very firm, very sticky and very plastic; few, very fine roots; slight effervescence; a few, fine, white masses of lime; strongly alkaline; clear, smooth boundary.

C1ca—42 to 54 inches, olive-gray (5Y 5/2) clay, olive (5Y 4/3) moist; massive; very hard, firm, very sticky and very plastic; strong effervescence; common, very fine segregated lime; strongly alkaline; clear, smooth boundary.

C2cs—54 to 60 inches, olive (5Y 5/3) light clay, olive (5Y 4/3) moist; massive; hard, firm, sticky and plastic; strong effervescence; common masses and seams of lime and crystalline gypsum; strongly alkaline.

The A horizon ranges from 4 to 8 inches in thickness. In places, the soil is free of lime to a depth of 40 inches or more, and in some places there is no segregated gypsum.

Nc—Nishon clay loam (0 to 2 percent slopes). This nearly level soil is in depressions and swales on uplands.

Runoff is ponded. The hazard of water erosion is slight, and the hazard of soil blowing is slight.

This soil is suited to small grain, tame pasture, and range. Capability unit IVw-1, dryland; Overflow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Novary Series

The Novary series consists of deep, poorly drained soils on low terraces. These soils formed in alluvium. Elevation ranges from 4,200 to 5,000 feet. Slopes are 0 to 2 percent. The native vegetation is mainly basin wildrye, prairie cordgrass, low and tall sedges, and northern reedgrass. The mean annual precipitation is 15 to 19 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 80 to 100 days.

In a representative profile the surface layer is dark-gray and gray loam and silt loam 26 inches thick. The underlying material is gray, stratified silt loam, silty clay loam, and sandy loam 16 inches thick over gray gravelly clay loam.

Permeability is moderate. Available water capacity is high. Seasonal high water table is at a depth of less than 2 feet. Reaction is moderately alkaline. Organic-matter content is high in the surface layer.

This soil is used mainly for tame pasture and range. Representative profile of Novary loam in native grass, 2,200 feet south and 30 feet east of the northwest corner of sec. 36, T. 33 N., R. 10 W.:

A11—0 to 6 inches, dark-gray (N 4/) loam, black (10YR 2/1) moist; moderate, fine, crumb structure; soft, friable, slightly sticky and slightly plastic; many fine to very fine and few medium roots; slight effervescence; moderately alkaline; clear, smooth boundary.

A12—6 to 26 inches, gray (N 5/) silt loam, with a few thin

($\frac{1}{4}$ to 1 inch) bands of sandy loam, black and very dark gray (10YR 2/1 and 3/1) moist; moderate, thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; common, fine and very fine roots; slight effervescence; moderately alkaline; gradual, smooth boundary.

C1g—26 to 32 inches, gray (5Y 5/1), stratified silt loam and silty clay loam, very dark gray (10YR 3/1) moist; few, fine, faint, pale-olive (5Y 6/3, dry) and brown (10YR 5/3, moist) mottles; massive; slightly hard, friable, sticky and plastic; common, very fine roots; slight effervescence; a few fine white mottles of lime; moderately alkaline; gradual, smooth boundary.

C2g—32 to 42 inches, gray (5Y 5/1) stratified silt loam, silty clay loam, and sandy loam, very dark gray (10YR 3/1) moist; many, fine, distinct, pale-olive (5Y 6/4, dry) and grayish-brown (2.5Y 5/2, moist) mottles; massive; hard, friable, sticky and plastic; common, very fine roots; slight effervescence; moderately alkaline; gradual, smooth boundary.

C3g—42 to 60 inches, gray (5Y 6/1) gravelly clay loam, olive gray (5Y 5/2) moist; many, coarse, distinct, light olive-brown (2.5Y 5/4, dry) and light olive-brown (2.5Y 5/6, moist) mottles; massive; hard, firm, sticky and plastic; 25 percent pebbles; moderately alkaline.

In places, the A1 horizon is covered by a mat, 1 to 3 inches thick, of fibrous roots. Below a depth of 42 inches the soil is gravelly sand, gravelly clay loam, or gravelly loam. The content of gravel ranges from 0 to 25 percent, by volume.

No—Novary loam (0 to 2 percent slopes). This nearly level soil is on low terraces.

Included with this soil in mapping are a few, small, very poorly drained areas of cutoff stream meanders. Also included are a few small saline areas.

Runoff is slow. The hazards of water erosion and soil blowing are slight. The water table is above a depth of 1 or 2 feet for prolonged periods during the growing season.

This soil is suited mainly to tame pasture and range. Capability unit Vw-1, dryland; Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3W.

Peat

PA—Peat (0 to 2 percent slopes). This land type is in several areas along Cut Bank Creek and Willow Creek. The total area of Peat is about 300 acres. Other areas of Peat are too small to map separately and are included with other soils.

Peat is generally fibrous and is 3 to 5 feet thick over sand, gravel, or sandy clay loam. Commonly included with this land type in mapping are Novary soils.

Peat is very poorly drained and has some areas of open water.

Vegetation is mainly a rank growth of sedges and rushes and some areas of cattail and willow. All areas are suited to native hay and pasture. Capability unit Vw-1, dryland; Wet Land range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Pendroy Series

The Pendroy series consists of deep, well-drained soils on uplands and on terraces. These soils formed

in clay sediment. Elevation ranges from 3,600 to 4,200 feet. Slopes are 0 to 8 percent. The native vegetation is mainly western and thickspike wheatgrass, green needlegrass, bluebunch wheatgrass, and some perennial forbs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown and light brownish-gray clay 5 inches thick. The underlying material is light brownish-gray and olive clay.

Permeability is very slow. Available water capacity is high. Reaction is mildly alkaline to a depth of 30 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for dryfarmed small grain, tame pasture, and range. Some areas are used for irrigated small grain, tame pasture, and hay.

Representative profile of Pendroy clay, 2 to 4 percent slopes, in a cultivated field, 1,320 feet south and 1,400 feet east of the northwest corner of sec. 24, T. 31 N., R. 6 W.:

Ap—0 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, very fine, granular structure; soft, friable, sticky and plastic; slight effervescence; mildly alkaline; abrupt, wavy boundary.

A12—3 to 5 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, fine, granular structure; slightly hard, friable, sticky and plastic; strong effervescence; mildly alkaline; abrupt, wavy boundary.

C1—5 to 12 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate, fine and very fine parallelepeds; very hard, firm, very sticky and very plastic; common intersecting slickensides; strong effervescence; mildly alkaline; gradual, wavy boundary.

C2—12 to 30 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure that parts to fine parallelepeds; very hard, firm, very sticky and very plastic; common intersecting slickensides; strong effervescence; mildly alkaline; clear, irregular boundary.

C3—30 to 60 inches, olive (5Y 5/3) clay, olive (5Y 4/3) moist; massive; very hard, firm, very sticky and very plastic; a few slickensides; strong effervescence; a few masses of white lime; moderately alkaline.

Pc—Pendroy clay, 0 to 2 percent slopes. This nearly level soil is on uplands.

Included with this soil in mapping are a few small areas of Dimmick soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-3, dryland, and IIIs-2, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Pd—Pendroy clay, 2 to 4 percent slopes. This gently sloping soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of nearly level Pendroy soils and poorly drained soils. Also included are small areas of Dimmick and Sunburst soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-3, dryland, and IIIe-2, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Pe—Pendroy clay, 4 to 8 percent slopes. This moderately sloping soil is on uplands.

Included with this soil in mapping are a few small areas of Pendroy soils that have a surface layer of silty clay. Also included are small areas of nearly level Pendroy clay and small areas of Sunburst soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-3, dryland, and IVe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Pf—Pendroy clay, shale substratum (0 to 4 percent slopes). This nearly level or gently sloping soil is on uplands or terraces. It has a profile similar to that described as representative of the series, but shale is at a depth of 48 to 60 inches.

Included with this soil in mapping are a few small areas of saline seeps and shallow soils on shaly knolls. Also included are small areas of Vanda soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Dense Clay range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Pishkun Series

The Pishkun series consists of deep, excessively drained soils on terrace escarpments. These soils formed in very gravelly and cobbly alluvium. Elevation ranges from 4,500 to 6,000 feet. Slopes are 8 to 50 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, and some forbs and shrubs. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 60 to 100 days.

In a representative profile the surface layer is very dark grayish-brown or pale-brown gravelly loam 10 inches thick. The underlying material is light brownish-gray very gravelly loam.

Permeability is rapid. Available water capacity is low. Reaction is mildly alkaline to a depth of 10 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Pishkun gravelly loam in an area of Pishkun-Adel association, steep, in native grass, 60 feet east and 50 feet north of the center of sec. 6, T. 36 N., R. 12 W.:

A11—0 to 4 inches, very dark grayish brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) moist; weak, fine, crumb structure; soft, very friable, non-sticky and nonplastic; many, very fine roots; many, fine and medium, interstitial pores; 20 percent pebbles; mildly alkaline; clear, irregular boundary.

A12—4 to 10 inches, pale-brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; weak, medium, sub-angular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common, very fine roots; common, fine and medium, interstitial pores and a few, medium, tubular pores; 20 percent pebbles and cobbles; slight effervescence; very thin lime coatings on lower sides of rock fragments; mildly alkaline; clear, wavy boundary.

C1—10 to 24 inches, light brownish-gray (10YR 6/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; massive; loose, very friable, nonsticky and nonplastic; common, very fine roots; 70 percent pebbles and cobbles; slight effervescence; moderately alkaline; gradual, smooth boundary.

C2ca—24 to 60 inches, light brownish-gray (10YR 6/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; massive; loose, very friable, nonsticky and nonplastic; few, very fine roots; strong effervescence; lime coatings on sand grains and pebbles; moderately alkaline.

Content of rock fragments ranges from 20 to 70 percent, by volume, throughout.

PH—Pishkun-Adel association, steep (8 to 50 percent slopes). This association consists of about 40 percent Pishkun gravelly loam that has slopes of 8 to 50 percent and 40 percent Adel loam that has slopes of 8 to 20 percent. The Pishkun soil is on the upper slopes of terrace escarpments. The Adel soil is on foot slopes and fans. Most of the Adel soil has some pebbles and cobbles throughout the profile.

Included with these soils in mapping, and making up 15 percent of the mapped area, are Michelson and Bynum soils. Also included are 5 percent shale, sandstone, or loose gravel outcrops and areas of poorly drained soils.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

The soils in this association are suited to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Playas

PL—Playas (0 to 2 percent slopes). This land type consists of strongly alkaline, clay soils in dry lake basins and bordering lakes. Small dunes of clay aggregates, which have blown from dry lake basins, often are around intermittent lakes. Included with these soils in mapping are some areas of very saline soils and parts of intermittent lakes.

These soils seal over and are very slowly permeable when wet. Water often stands in small depressions until it evaporates.

Vegetation is mainly greasewood, saltbush, saltgrass, foxtail barley, and western wheatgrass. The amount of available forage is low. Capability unit VIIs-1, dryland; Saline Upland range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Raynesford Series

The Raynesford series consists of deep, well-drained soils on uplands. These soils formed in glacial till derived from limestone. Elevation ranges from 4,300 to 5,200 feet. Slopes are 2 to 20 percent. The native

vegetation is mainly rough fescue, bluebunch wheatgrass, and Idaho fescue. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 95 days.

In a representative profile the surface layer is dark-gray and dark grayish-brown gravelly loam 9 inches thick. The underlying material is light-gray, light brownish-gray, and pale-yellow gravelly loam.

Permeability is moderately slow. Available water capacity is moderate or high. Reaction is neutral or mildly alkaline in the surface layer and moderately alkaline below the surface layer. Organic-matter content is medium or high in the surface layer.

These soils are used for native range.

Representative profile of Raynesford gravelly loam in an area of Raynesford-Bear Lake complex, rolling, in native grass, 1,200 feet west and 700 feet south of the center of sec. 1, T. 28 N., R. 10 W.:

- A11—0 to 2 inches, dark gray (10YR 4/1) gravelly loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; many, fine and medium roots; 20 percent pebbles; neutral; clear, irregular boundary.
- A12—2 to 9 inches, dark grayish-brown (10YR 4/2) gravelly loam, dark brown (10YR 3/3) moist; weak, medium, angular blocky structure that parts to moderate, very fine crumbs; slightly hard, very friable, slightly sticky and nonplastic; many, very fine and medium roots; 20 percent pebbles; slight effervescence; mildly alkaline; clear, smooth boundary.
- C1ca—9 to 19 inches, light-gray (10YR 7/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak, medium and fine, angular blocky structure; soft, very friable, slightly sticky and slightly plastic; common, fine and medium roots; 25 percent pebbles; strong effervescence; crusts of lime on pebbles but some leaching of lime in the upper part; moderately alkaline; clear, smooth boundary.
- C2ca—19 to 50 inches, light brownish-gray (2.5Y 6/2) gravelly loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many, fine and medium roots; 20 percent pebbles; violent effervescence; 30 to 40 percent of the matrix is white, when dry, from lime segregation; lime crusts on pebbles; moderately alkaline; gradual, smooth boundary.
- C3—50 to 62 inches, pale-yellow (5Y 7/3) gravelly loam, olive (5Y 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; 20 percent pebbles; strong effervescence; moderately alkaline.

Content of rock fragments ranges from 20 to 35 percent, by volume, throughout. The A1 horizon ranges from 6 to 14 inches in thickness. The A1 horizon is grayish brown, dark gray, or dark grayish brown.

RC—Raynesford-Bear Lake complex, rolling (0 to 8 percent slopes). This complex is on uplands. It is about 60 percent Raynesford gravelly loam and 30 percent Bear Lake silty clay loam. Slopes are mainly 4 to 8 percent. Raynesford gravelly loam is mainly on broad ridges and hills and has slopes of 2 to 8 percent. The poorly drained Bear Lake silty clay loam is in swales and basins and has slopes of less than 2 percent. The Raynesford soil has the profile described as representative of the Raynesford series. The Bear Lake soil has a profile similar to that described as representative of the Bear Lake series, but the surface layer is thicker and darker and contains more organic matter.

Included with these soils in mapping, and making up 10 percent of the mapped area, are Adel, Hanson,

and Whitore soils. Also included are a few small areas of very poorly drained soils.

Runoff is medium on the Raynesford soil and slow on the Bear Lake soil. The hazard of water erosion is moderate on the Raynesford soil and slight on the Bear Lake soil, and the hazard of soil blowing is slight or moderate on both soils.

The soils in this complex are suited mainly to range. Capability unit VIe-1, dryland; Raynesford part in Silty range site, 15- to 19-inch precipitation zone, Bear Lake part in Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; Raynesford part in windbreak suitability group 2L, Bear Lake part in windbreak suitability group 3W.

RD—Raynesford-Hanson complex, hilly (4 to 20 percent slopes). This complex is on uplands. It is about 60 percent Raynesford gravelly loam and 35 percent Hanson stony loam. Slopes are mainly 8 to 15 percent. Raynesford gravelly loam is on hills and foot slopes, and Hanson stony loam is on ridges and hilltops.

Included with these soils in mapping are a few small areas of wet soils in depressions.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited mainly to range. Capability unit VIe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Redchief Series

The Redchief series consists of deep, well-drained soils on terraces. These soils formed in glacial outwash. Elevation ranges from 5,000 to 6,000 feet. Slopes are 2 to 8 percent. The native vegetation is mainly rough fescue, bluebunch wheatgrass, Idaho fescue, Columbia and green needlegrass, and some forbs and woody plants. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 37° to 41° F, and the growing season is 60 to 80 days.

In a representative profile the surface layer is black and dark grayish-brown cobbly loam 7 inches thick. The upper part of the subsoil is yellowish-brown gravelly clay loam 6 inches thick, the middle part is strong-brown and yellowish-red gravelly clay 21 inches thick, and the lower part is reddish-brown very gravelly clay 26 inches thick.

Permeability is slow. Available water capacity is moderate. Reaction is medium acid in the surface layer, strongly acid in the upper part of the subsoil and medium acid in the lower part of the subsoil. Organic-matter content is high in the surface layer.

These soils are used mainly for range and tame pasture.

Representative profile of Redchief cobbly loam, gently sloping, in native grass, 200 feet north and 50 feet east of the center of sec. 10, T. 34 N., R. 13 W.:

- A11—0 to 3 inches, black (10YR 2/1) cobbly loam, black (10YR 2/1) moist; weak, fine, crumb structure; soft, very friable, nonsticky and nonplastic; common, fine roots; common, fine, interstitial pores; 25 percent cobbles and pebbles; medium acid; abrupt, smooth boundary.
- A12—3 to 7 inches, dark grayish-brown (10YR 4/2) cobbly

loam, dark brown (10YR 3/3) moist; moderate, fine, angular blocky structure that parts to moderate, fine granules; soft, very friable, slightly sticky and nonplastic; common, fine roots; common, fine, interstitial pores; peds coated with very dark grayish brown (10YR 3/2), moist; 25 percent cobbles and pebbles; medium acid; clear, irregular boundary.

B21t—7 to 13 inches, yellowish-brown (10YR 5/4) gravelly clay loam, dark brown (10YR 4/3) moist; moderate, fine, angular blocky structure; slightly hard, friable, sticky and slightly plastic; common, fine roots; common, fine, tubular pores; dark-brown (10YR 3/3) coats on peds when moist; common, thin clay films on peds; 30 percent pebbles and cobbles; strongly acid; clear, wavy boundary.

B22t—13 to 19 inches, strong-brown (7.5YR 5/6) gravelly light clay, yellowish red (5YR 5/6) moist; moderate, fine, angular blocky structure; hard, firm, very sticky and plastic; common, fine roots; common, fine, tubular pores; common, moderately thick clay films on peds; 35 percent pebbles and cobbles; strongly acid; clear, wavy boundary.

B23t—19 to 34 inches, yellowish-red (5YR 4/8) gravelly clay, yellowish red (5YR 4/8) moist; moderate, fine, angular blocky structure; very hard, very firm, very sticky and very plastic; common, fine roots; few, fine, tubular pores; 40 percent pebbles and cobbles; many, thick, red (2.5YR 4/8) clay films on peds; strongly acid; gradual, wavy boundary.

B24t—34 to 60 inches, light reddish-brown (5YR 6/4) very gravelly clay, yellowish red (5YR 4/8) moist; moderate, fine, angular blocky structure; very hard, very firm, very sticky and very plastic; few, fine roots; very fine, tubular pores; 65 percent pebbles and cobbles; many, thick clay films on peds and pebbles; medium acid.

The content of rock fragments ranges from 25 to 70 percent, by volume, throughout.

Re—Redchief cobbly loam, gently sloping (2 to 4 percent slopes). This soil is on long, smooth parts of terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Michelson, Leavitt, and Sherburne soils.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to range and tame pasture. Capability unit IVe-4, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Rf—Redchief cobbly loam, sloping (4 to 8 percent slopes). This soil is on terraces.

Included with this soil in mapping are a few small areas of Michelson, Leavitt, and Sherburne soils. Also included are a few small areas of Adel soils at the heads of drainageways.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to range and tame pasture. Capability unit IVe-1, dryland; Silty range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Reeder Series

The Reeder series consists of moderately deep, well-drained soils on uplands. They formed in material weathered from shale. Elevation ranges from 4,200 to 4,700 feet. Slopes are 2 to 8 percent. The native vege-

tation is mainly bluebunch wheatgrass, needleand-thread, western and thickspike wheatgrass, and some forbs and shrubs. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is dark grayish-brown silt loam 6 inches thick. The subsoil is brown silty clay loam 11 inches thick. The substratum is light-gray silt loam 21 inches thick over light-gray shale.

Permeability is moderate. Available water capacity is low or moderate. Reaction is neutral to a depth of 17 inches and mildly alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed small grain with summer fallow. Some areas are used for range and tame pasture.

Representative profile of Reeder silt loam, undulating, in a cultivated field, 1,600 feet west and 300 feet north of the southeast corner of sec. 16, T. 35 N., R. 9 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt, smooth boundary.

B21t—6 to 12 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure that parts to moderate, medium angular blocks; hard, very friable, sticky and plastic; common, thin, very dark grayish-brown (10YR 3/2) clay films on peds; neutral; clear, smooth boundary.

B22t—12 to 17 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure; hard, very friable, sticky and plastic; thin, discontinuous clay films on peds; neutral; clear, irregular boundary.

C1ca—17 to 38 inches, light-gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; weak, coarse, prismatic structure; hard, very friable, slightly sticky and slightly plastic; very strong effervescence; common spots of lime; mildly alkaline; clear, wavy boundary.

IIC2—38 to 60 inches, light-gray shale.

The combined thickness of the A and B horizons range from 10 to 18 inches. The depth to partly weathered shale ranges from 30 to 40 inches.

Rg—Reeder silt loam, undulating (2 to 8 percent slopes). This soil is on uplands. It has the profile described as representative of the series. Slopes are complex and are mainly 2 to 4 percent.

Included with this soil in mapping are small areas of soils that have a loam surface layer and small areas of Arnegard soils in swales and Cabba soils on the points of ridges and hilltops. Also included, on a high plateau northwest of Buffalo Lake, are some areas of soils that have a surface layer of sandy loam, a subsoil of sandy clay loam, and underlying material of sandstone. These soils have slightly less available water capacity and have a greater hazard of soil blowing than this Reeder soil. They require more intensive but similar management to control soil blowing than is required for Reeder silt loam. The total acreage of this sandy loam soil is about 1,700 acres, most of which is cultivated.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain with

summer fallow. It is also well suited to range and to tame pasture. Capability unit IIIe-2, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Rh—Reeder-Arnegard complex, undulating (2 to 8 percent slopes). This complex consists of about 70 percent Reeder silt loam and 30 percent Arnegard loam. Slopes are mainly 2 to 4 percent. The Reeder soil is on broad ridges, and the Arnegard soil is in swales and on foot slopes.

Included with these soils in mapping are a few small areas of soils that have a slowly permeable clay subsoil. Also included are a few small areas of Cabba soils on ridge points and hilltops.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are suited to dryfarmed small grain with summer fallow. They are also well suited to range and to tame pasture. Capability unit IIIe-2, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Reeder part in windbreak suitability group 2M, Arnegard part not assigned to a windbreak suitability group.

Rentsac Series

The Rentsac series consists of shallow, excessively drained soils on ridges and side slopes of terraces. These soils formed in material weathered from hard sandstone. Elevation ranges from 3,400 to 4,300 feet. Slopes are 2 to 60 percent. The native vegetation is mainly bluebunch wheatgrass, western and thickspike wheatgrass, and needleandthread. The mean annual precipitation is 10 to 15 inches, the mean annual air temperature is 39° to 41° F, and the frost-free season is 100 to 110 days.

In a representative profile the surface layer is light brownish-gray stony loam 3 inches thick. The underlying material is light yellowish-brown stony loam and stony sandy loam 15 inches thick. Hard sandstone is at a depth of 18 inches.

Permeability is moderately rapid. Available water capacity is very low. Reaction is mildly alkaline to a depth of 3 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Rentsac stony loam, rolling, in native grass, 1,300 feet north and 1,100 feet west of southeast corner of sec. 13, T. 35 N., R. 7 W.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) stony loam, dark grayish brown (10YR 4/2) moist; weak, very fine, crumb structure in upper part and weak, very thin, platy structure in lower part; soft, very friable, slightly sticky and nonplastic; 40 percent rock fragments; slight effervescence; mildly alkaline; clear, wavy boundary.

C1ca—3 to 9 inches, light yellowish-brown (10YR 6/4) stony loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; 40 percent rock fragments; strong effervescence; common threads of lime; moderately alkaline; clear, wavy boundary.

C2ca—9 to 18 inches, light yellowish-brown (10YR 6/4) stony sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, non-

sticky and nonplastic; 60 percent rock fragments; strong effervescence; common threads of lime; lime crusted on bottom of rock fragments; moderately alkaline; clear, wavy boundary.

R—18 to 22 inches, hard sandstone.

The A1 horizon ranges from pale brown to gray. Depth to hard sandstone ranges from 14 to 20 inches. The content of rock fragments ranges from 40 to 60 percent, by volume, throughout.

RK—Rentsac-Rock outcrop complex, very steep (15 to 60 percent slopes). This complex is on side slopes of bedrock-floored terraces on uplands (fig. 2). It is about 50 percent Rentsac stony loam and 30 percent Rock outcrop. Slopes are mainly 35 to 60 percent.

Included in mapping are 20 percent other soils, mainly small areas of Cabba, Scobey, Tally, Kevin, and Fairfield soils. Also included are springs and small seeps.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited to range. Areas of Rock outcrop provide little or no usable forage. Capability unit VIIe-1, dryland; Rentsac part in Shallow range site, 12- to 14-inch precipitation zone, Rock outcrop part not assigned to a range site or windbreak suitability group; not assigned to a woodland suitability group; windbreak suitability group 4.

Rm—Rentsac stony loam, undulating (2 to 4 percent slopes). This soil is on bedrock-floored terraces and narrow ridgetops in uplands. Slopes are mainly 2 to 4 percent.

Included with this soil in mapping are a few small areas of Cabba, Scobey, Tally, Kevin, and Fairfield soils. Also included are a few small areas of soils that have slopes somewhat greater than 4 percent and small areas of Rock outcrop.

Runoff is slow or medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

This soil is suited to range. Capability unit VI-1, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Rn—Rentsac stony loam, rolling (4 to 15 percent slopes). This soil is on bedrock-floored terraces in uplands. Slopes are mainly 4 to 8 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Cabba, Scobey, Tally, Kevin, and Fairfield soils. Also included are a few small areas of Rock outcrop.

Runoff is medium or rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

This soil is suited mainly to range. Capability unit VI-1, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Rhoades Series

The Rhoades series consists of deep, moderately well-drained soils on terraces and uplands. These soils formed in alluvium derived from shale. Elevation ranges from 4,200 to 5,000 feet. Slopes are 0 to 4 per-



Figure 2.—An area of Rentsac-Rock outcrop complex, very steep, along Cut Bank Creek.

cent. The native vegetation is mainly western and thickspike wheatgrass, rough fescue, and green needlegrass. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 85 to 100 days.

In a representative profile the surface layer is dark-gray clay loam 3 inches thick. The upper part of the subsoil is dark grayish-brown and grayish-brown clay 7 inches thick, and the lower part is light-gray clay loam 14 inches thick. The substratum is white gravelly clay loam.

Permeability is very slow. Available water capacity is moderate or high. Reaction is moderately alkaline to a depth of 3 inches and strongly alkaline below that depth. Organic-matter content is low or medium in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed small grain and tame pasture.

Representative profile of Rhoades clay loam in an area of Rhoades complex in native grass, 1,300 feet north and 600 feet east of southwest corner of sec. 22, T. 35 N., R. 12 W.:

- A1—0 to 3 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak, fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; moderately alkaline; clear, wavy boundary.
- B21t—3 to 6 inches, dark grayish-brown (10YR 4/2) clay, very dark brown (10YR 2/2) moist; strong, coarse, columnar structure; extremely hard, very firm, very sticky and very plastic; ped tops coated with gray (10YR 5/1) and sides coated with very dark gray

- (10YR 3/1); thin clay films on peds; strongly alkaline; clear, smooth boundary.
- B22t—6 to 10 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; strong, coarse, prismatic structure that parts to strong, medium angular blocks; very hard, very firm, very sticky and very plastic; ped tops coated with gray (10YR 5/1) and sides coated with very dark gray (10YR 3/1); thin clay films on peds; slight effervescence; strongly alkaline; clear, irregular boundary.
- B3ca—10 to 24 inches, light-gray (5Y 7/1) clay loam, olive gray (5Y 5/2) moist; weak, coarse, prismatic structure; hard, friable, sticky and plastic; some disseminated lime; strongly alkaline; gradual, smooth boundary.
- Cca—24 to 60 inches, white (5Y 8/2) gravelly clay loam, olive gray (5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 20 percent pebbles; strong effervescence; soft masses of lime; strongly alkaline.

The A1 horizon is loam or clay loam, and ranges from 2 to 5 inches in thickness. The content of pebbles below a depth of 24 inches ranges from 15 to 25 percent, by volume.

Ro—Rhoades complex (0 to 4 percent slopes). This complex of nearly level and gently sloping soils is on terraces and uplands. This complex is about 50 percent Rhoades clay loam and 20 percent Rhoades loam.

Included with these soils in mapping are 15 percent areas of Litimber, Farnuf, Savage, and Timberg soils and soils in which shale is at a depth of 4 to 6 feet. Also included are 15 percent areas of barren or nearly barren clay and strongly saline soils in depressions.

Runoff is slow or medium. The hazard of water ero-

sion is moderate, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited to range. Little or no usable forage is produced in the areas of barren clay. Capability unit VIs-1, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Riverwash

RS—Riverwash (0 to 2 percent slopes). This land type consists of areas of nearly barren gravel, mainly along Birch Creek and Saint Mary River. There are small areas of Riverwash scattered along the other major streams, but they are too small to show on the map and are included in the stream channel. Areas of Riverwash range from 5 acres to several hundred acres in size. Included with this soil in mapping are a few areas of soils covered with brush.

Many areas are flooded and reworked during spring floods.

Areas of this land type have little value for farming; however, these areas are a good source of gravel. Capability unit VIIIs-1, dryland; not assigned to a range site or a woodland suitability group; windbreak suitability group 4.

Rock Land

Rock land consists of areas in which rock outcrop and very shallow soil dominate other soil characteristics. The rock outcrop covers 50 to 90 percent of the mapped area.

Rock land is mapped only in association with Bridger, Swifton, and Mord soils.

Rock Outcrop

RT—Rock outcrop (15 to 100 percent slopes). This land type consists of nearly barren areas of limestone, sandstone, and shale and talus slopes below these areas of exposed bedrock. Areas of Rock outcrop range from 5 acres to several hundred acres in size and are throughout the survey area.

Included with this land type in mapping are a few areas of soils that have grass, shrubs, or evergreens, but in general these areas have no farming value.

The areas of limestone and a few of the areas of sandstone are a good source of rock for riprap. Capability unit VIIIs-1, dryland; not assigned to a range site or a woodland suitability group; windbreak suitability group 4.

Saline Land

SA—Saline land (0 to 15 percent slopes). This land type is in swales, basins, and hillside seeps in the valleys and uplands. It consists of various nearly level to moderately steep, saline soils that have restricted drainage. Most areas of these soils are clay loam but range from loam to clay. Areas of Saline land range from 5 acres to several hundred acres in size. Saline land is in most parts of the survey area but is less common in the western part.

A temporary water table is within a depth of 2 feet of the surface in most years. Alkali salts are commonly visible whenever the surface layer dries.

Most areas of these soils are used for range. There are a few cultivated areas in or bordering farmed fields of other soils, but they are difficult to manage and are often seeded to tall wheatgrass or smooth brome. Capability unit VIw-1, dryland; Saline Lowland range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Savage Series

The Savage series consists of deep, well-drained soils on terraces, outwash fans, and uplands. These soils formed in alluvium. Elevation ranges from 4,100 to 4,600 feet. Slopes are 0 to 8 percent. The native vegetation is mainly western and thickspike wheatgrass, green needlegrass, bluebunch wheatgrass, and some perennial forbs. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 105 days.

In a representative profile the surface layer is dark grayish-brown silt loam and clay loam 4 inches thick. The upper part of the subsoil is grayish-brown heavy clay loam 6 inches thick, the middle part is light brownish-gray heavy clay loam 5 inches thick, and the lower part is light-gray clay loam 7 inches thick. The substratum is light-gray clay loam.

Permeability is moderately slow. Available water capacity is high. Reaction is neutral to a depth of 10 inches, mildly alkaline between depths of 10 and 15 inches, and moderately alkaline below a depth of 15 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for small grain, tame pasture, and range. Some areas are used for irrigated small grain, tame pasture, and hay.

Representative profile of Savage clay loam, 0 to 2 percent slopes, in native grass, 600 feet east and 1,320 feet south of the northwest corner of sec. 24, T. 34 N., R. 12 W.:

- A11—0 to 1 inch, dark grayish-brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) moist; moderate, very fine, crumb structure; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt, smooth boundary.
- A12—1 to 4 inches, dark grayish-brown (10YR 4/2) light clay loam, very dark grayish brown (10YR 3/2) moist; strong, very fine, granular structure; hard, friable, sticky and plastic; neutral; clear, irregular boundary.
- B21t—4 to 10 inches, grayish-brown (10YR 5/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; strong, fine, prismatic structure that parts to strong, very fine subangular blocks; very hard, firm, very sticky and plastic; common, thin clay films on ped; neutral; clear, irregular boundary.
- B22t—10 to 15 inches, light brownish-gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure that parts to moderate, medium angular blocks; very hard, firm, very sticky and plastic; common, moderately thick, grayish-brown (10YR 5/2) clay films on ped; slight effervescence; mildly alkaline; clear, smooth boundary.
- B3ca—15 to 22 inches, light-gray (2.5Y 7/2) clay loam, olive gray (5Y 5/2) moist; moderate, medium,

prismatic structure that parts to weak, medium angular blocks; hard, firm, sticky and plastic; strong effervescence; moderately alkaline; clear, smooth boundary.

C1ca—22 to 31 inches, light-gray (5Y 7/2) clay loam, olive gray (5Y 5/2) moist; weak, coarse, prismatic structure that parts to weak, medium plates; hard, friable, sticky and plastic; common masses and seams of white segregated lime; moderately alkaline; gradual, smooth boundary.

C2—31 to 60 inches, light gray (5Y 7/2) clay loam, light olive gray (5Y 6/2) moist; massive; hard, firm, sticky and plastic; few white lime masses and seams in matrix; moderately alkaline.

In some places the C2 horizon is stratified clay loam, sandy clay loam, and silty clay loam.

Sb—Savage clay loam, 0 to 2 percent slopes. This nearly level soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have slight effervescence in the surface layer. Also included are small areas of Rhoades soils and Savage silty clay loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-1, dryland, and IIIe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Sc—Savage clay loam, 2 to 4 percent slopes. This gently sloping soil is on terraces and outwash fans.

Included with this soil in mapping are a few small areas of soils that have slight effervescence in the surface layer. Also included are small areas of Rhoades soils and Savage silty clay loam.

Runoff is slow or medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed and irrigated small grain, tame pasture, and hay. It is also suited to range. Capability units IIIe-2, dryland, and IIIe-1, irrigated; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Sd—Savage clay loam, undulating (2 to 8 percent slopes). This soil is on uplands. Slopes are mainly 2 to 4 percent.

Included with this soil in mapping are a few small areas of soils that have slight effervescence in the surface layer. Also included are small areas of soils in which shale is at a depth of 5 to 6 feet. Small areas of Rhoades soils and saline seeps are also included.

Runoff is slow or medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and hay. It is also suited to range. Capability unit IIIe-2, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Se—Savage-Rhoades clay loams, 0 to 4 percent slopes. This complex of nearly level and gently sloping soils is on uplands. This complex is about 80 percent Savage clay loam and 15 percent Rhoades clay loam. Slopes are mainly 0 to 2 percent. The Rhoades soil is in swales. Annual precipitation is about 16 inches, and the growing season is about 95 days.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are saline seeps and Savage and Rhoades soils that have a few cobbles in the surface layer.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soils in this complex are suited to dryfarmed small grain, tame pasture, and hay. They are also suited to range. Capability unit IIIe-1, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; Savage part in windbreak suitability group 1, Rhoades part in windbreak suitability group 4.

Sf—Savage-Wayden clay loams, rolling (4 to 15 percent slopes). This complex is on uplands. This complex is about 70 percent Savage clay loam and 20 percent Wayden clay loam. Slopes are mainly 4 to 8 percent. The Savage soil is on foot slopes and in swales. The Wayden soil is on ridges, knolls, and south-facing slopes. Annual precipitation is about 14 inches, and the growing season is about 105 days.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are claypan soils, clay loam soils that are moderately deep to shale, Shale outcrop, and soils that have somewhat greater slopes.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

The soils in this complex are suited to small grain, tame pasture, and range. Capability unit IVE-3, dryland; Savage part in Clayey range site, 12- to 14-inch precipitation zone, Wayden part in Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Savage part in windbreak suitability group 1, Wayden part in windbreak suitability group 3M.

Scobey Series

The Scobey series consists of deep, well-drained soils on uplands. These soils formed in clay loam glacial till. Elevation ranges from 3,600 to 4,200 feet. Slopes are 2 to 15 percent. The native vegetation is mainly green needlegrass, western and thickspike wheatgrass, bluebunch wheatgrass, and some perennial forbs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is gray loam 3 inches thick. The subsoil is grayish-brown and brown clay loam 12 inches thick. The substratum is grayish-brown, gray, and light brownish-gray clay loam to a depth of 60 inches.

Permeability is moderately slow. Available water capacity is high. Reaction is neutral to a depth of 6 inches, mildly alkaline between depths of 6 and 15 inches, and moderately alkaline below a depth of 15 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for small grain, tame pasture, and range.

Representative profile of Scobey loam in an area of Scobey-Kevin loams, undulating, in native grass, 660 feet north and 40 feet east of the southwest corner of sec. 13, T. 37 N., R. 6 W.:

- A1—0 to 3 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, angular blocky and moderate, fine, granular structure; slightly hard, very friable, nonsticky and slightly plastic; neutral; abrupt, smooth boundary.
- B1—3 to 6 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocks; hard, friable, slightly sticky and slightly plastic; thin clay films on vertical ped faces; neutral; clear, smooth boundary.
- B2t—6 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure that parts to strong, fine angular blocks; very hard, friable, slightly sticky and plastic; thin, continuous clay films on peds; mildly alkaline; clear, broken boundary.
- C1ca—15 to 18 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure; hard, friable, slightly sticky and slightly plastic; thin, discontinuous clay films on peds; a few pebbles; strong effervescence; moderately alkaline; clear, broken boundary.
- C2ca—18 to 30 inches, gray (10YR 6/1) light clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; 5 percent pebbles; strong effervescence; many fine threads of white lime; moderately alkaline; gradual, smooth boundary.
- C3—30 to 60 inches, light brownish-gray (10YR 6/2) heavy clay loam, grayish brown (10YR 5/2) moist; massive; hard, firm, sticky and plastic; 5 percent pebbles; strong effervescence; moderately alkaline.

Where the soils are in native sod, the A1 horizon ranges from 3 to 5 inches in thickness. The combined thickness of the A and B horizons range from 10 to 18 inches. In places there is a horizon that contains gypsum at a depth of 4 to 5 feet.

Sg—Scobey clay loam, 2 to 4 percent slopes. This gently sloping soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and the segregated lime is not so prominent in the underlying material.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Sh—Scobey clay loam, 4 to 8 percent slopes. This moderately sloping soil is on uplands. It has a profile similar to that described as representative of the series, but the surface layer is clay loam and the lime segregation is not so prominent in the underlying material.

Included with this soil in mapping are a few small areas of soils that have been eroded and in which the plow layer is calcareous.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Sk—Scobey-Kevin loams, undulating (2 to 8 percent slopes). This complex is on uplands. It is about 65 percent Scobey loam and 30 percent Kevin loam. Slopes are mainly 2 to 4 percent. The Scobey soil is in con-

cave areas, and the Kevin soil is in convex areas. The Scobey soil has the profile described as representative of the Scobey series. The Kevin soil has a profile similar to that described as representative of the Kevin series.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are areas of soils on knolls and ridges that have a very thin, light-colored loam or gravelly loam surface layer. Also included are intermittent lakes and areas of poorly drained soils that may have a narrow band of saline soils just above the water level.

Runoff is slow or medium, and much of the water collects in swales and basins. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

The soils in this complex are suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Scobey part in windbreak suitability group 1, Kevin part in windbreak suitability group 2L.

Sm—Scobey-Kevin loams, rolling (4 to 15 percent slopes). This complex is on uplands. It is about 65 percent Scobey loam and 25 percent Kevin loam. Slopes are mainly 4 to 8 percent. The Scobey soil is on side slopes and has slopes of 4 to 8 percent. The Kevin soil is on knolls and ridges and has slopes of 4 to 15 percent.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are gravelly soils on ridges, Arnegard soils on foot slopes and in well-drained swales, and poorly drained Nishon soils in swales and basins.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

The soils in this complex are suited to range. They are suited to small grain and tame pasture. Capability unit IVe-3, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Scobey part in windbreak suitability group 1, Kevin part in windbreak suitability group 2L.

Sn—Scobey-Kevin clay loams, undulating (2 to 8 percent slopes). This complex is on uplands. It is about 65 percent Scobey clay loam and about 30 percent Kevin clay loam. Slopes are mainly 2 to 4 percent. The Scobey soil is in concave areas, and the Kevin soil is in convex areas. Scobey and Kevin soils have profiles similar to those described as representative of their respective series, but the surface layer is a clay loam.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are Sunburst and Nishon soils.

Runoff is slow or medium. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are suited to small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Scobey part in windbreak suitability group 1, Kevin part in windbreak suitability group 2L.

SO—Scobey-Zahl complex, hilly (4 to 35 percent slopes). This complex is on uplands. It is about 50

percent Scobey loam, 30 percent Zahl gravelly loam, and 15 percent Kevin loam. Slopes are mainly 8 to 15 percent. The Zahl soil is on ridges and knolls, and the Kevin and Scobey soils are on side slopes. The Scobey soil has slopes of 4 to 8 percent, the Zahl soil has slopes of 8 to 35 percent, and the Kevin soil has slopes of 4 to 15 percent. The Scobey, Zahl, and Kevin soils have profiles similar to those described as representative of their respective series, but the Zahl soil has a lighter colored, gravelly surface layer.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are Arnegard soils at the base of steep slopes, and poorly drained Nishon soils in swales and basins.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Seeped Alluvial Land

SP—Seeped alluvial land (0 to 2 percent slopes). This land type consists of various soils in low positions along the major streams. Areas of these soils commonly range from 10 to 80 acres. Many areas are long and narrow strips that border streams or follow old cutoff channels. These soils have a thin organic root mat and are mainly loam or sandy loam 20 to 40 inches thick over sand and gravel. They are mildly calcareous throughout, but they commonly do not have accumulations of soluble salt.

These soils receive supplemental moisture from a fluctuating water table, and some areas are flooded by streams.

Most areas of these soils are used for native hay and range. Many areas have some potential for improvement through drainage, reseeding, or irrigation, but more detailed soil investigation is needed. Capability unit Vw-1, dryland; Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3W.

Shale Outcrop

Shale outcrop consists of barren or nearly barren exposures of shale and recent sediment below the exposed shale. These areas produce little or no usable forage.

Shale outcrop is mapped only in complexes with Doby and Wayden soils.

Sherburne Series

The Sherburne series consists of deep, well-drained, forested soils on the uplands and the adjacent mountains. These soils formed in remnants of old high level plains and terraces. Elevation ranges from 5,500 to 6,500 feet. Slopes are 2 to 35 percent. The native vegetation is mainly lodgepole pine, alpine fir, and Engelmann spruce and an understory mainly of shrubs and forbs. The mean annual precipitation is 20 to 35 inches,

the mean annual air temperature is 34° to 38° F, and the growing season is 60 to 90 days.

In a representative profile there is a layer of forest litter 1 inch thick on the surface. The surface layer is light-gray gravelly loam 1½ inches thick. The subsoil is light yellowish-brown, very pale brown, and reddish-yellow gravelly loam, gravelly clay loam, and cobbly clay about 88 inches thick. The substratum is light yellowish-brown clay.

Permeability is slow. Available water capacity is moderate. Reaction is very strongly acid to a depth of 10 inches and strongly acid below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for woodland and watershed.

Representative profile of Sherburne gravelly loam, sloping, in woodland, 1.9 miles north on Hilton Sawmill road off U.S. Highway 89 at milepost 440, 400 feet west and 600 feet south of northeast corner of sec. 11, T. 34 N., R. 14 W.:

- O1—¾ to ½ inch, fresh needles and twigs; a few pebbles and cobbles are exposed at the surface.
- O2—½ inch to 0, platy, matted, partially decayed organic material; very strongly acid; abrupt, smooth boundary.
- A2—0 to 1½ inches, light-gray (10YR 7/2) gravelly loam, grayish brown (10YR 5/2) moist; weak, thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; many, very fine roots; many, very fine, tubular pores and common, fine, vesicular and tubular pores; 25 percent subangular pebbles; silt, sand, and pebbles are uncoated; very strongly acid; abrupt, smooth boundary.
- B21ir—1½ to 10 inches, light yellowish-brown (10YR 6/2) gravelly loam, dark brown (7.5YR 4/4) moist; moderate, very fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many, mostly horizontal, very fine roots and a few, fine roots; many very fine and few fine tubular pores; 30 percent pebbles; silt, sand, and pebbles stained and pebbles coated with silt; very strongly acid; clear, wavy boundary.
- B22ir—10 to 18 inches, very pale brown (10YR 7/3) gravelly loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine and few fine tubular pores; 30 percent pebbles; silt, sand, and pebbles stained and pebbles coated with silt; strongly acid; clear, wavy boundary.
- IIB'21t—18 to 46 inches, light yellowish-brown (10YR 6/4) gravelly clay loam, brown (7.5YR 4/4) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; common very fine and few fine roots; many very fine and few fine tubular pores; 40 percent pebbles; clay bridging sand and patches of clay films on pebbles and on walls of pebble sockets; silt and sand grains stained; strongly acid; clear, wavy boundary.
- IIB'22t—46 to 90 inches, reddish-yellow (7.5YR 6/6) very cobbly clay, yellowish red (5YR 4/6) moist; moderate, thick, platy structure that parts to moderate, fine angular blocks; extremely hard, very firm, sticky and plastic; few roots; many, very fine, tubular pores and common, fine, interstitial pores; 30 percent cobbles and 20 percent pebbles; patches of thick clay films on pebbles, clay bridges on sand grains; patches of unstained sand; strongly acid; clear, wavy boundary.
- IIIC—90 to 100 inches, light yellowish-brown (10YR 6/4) clay, brown (7.5YR 5/4) moist; massive; extremely hard, friable, sticky and plastic; 10 percent pebbles; slightly acid.

The O horizon ranges from ½ inch to 2 inches in thick-

ness and is underlain by an A2 horizon 1 inch to 2 inches thick. To a depth of 18 inches, content of rock fragments ranges from 20 to 40 percent, by volume, and below this depth it ranges from 40 to 70 percent.

Sr—Sherburne gravelly loam, sloping (2 to 8 percent slopes). This soil is on upland terraces along the mountains. Slopes are mainly 4 to 8 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have slopes of 8 to 15 percent, and small areas of Loberg, Tenex, Swifton, Garlet, and Redchief soils.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

This soil is suited mainly to woodland and to use as watershed. Capability unit IVe-1, dryland; not assigned to a range site; woodland suitability group 5o1; windbreak suitability group 2M.

SS—Sherburne gravelly loam, steep (15 to 35 percent slopes). This steep soil is on terrace edges on uplands.

Included with this soil in mapping are small areas of Loberg and Swifton soils.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

This soil is suited mainly to woodland and to use as watershed. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 5r1; windbreak suitability group 4.

Stony Land

ST—Stony land (4 to 10 percent slopes). This land type consists of very stony, windswept alpine areas northeast of Sherburne Mountain and east of Divide Mountain. The combined acreage of these two areas is about 800 acres. Elevation ranges from 6,600 to 7,400 feet. Slopes are mostly less than 10 percent. The surface layer commonly contains many fragments of limestone and quartzite or argillite less than 1 inch to several feet in diameter. Stone rings, polygons, and terraces are poorly formed in places. The stones or the thin organic mat are underlain by brown or yellowish-brown, noncalcareous stony loam.

Vegetation consists of moss, sedges, wildflowers, and windpruned spruce. Patches of the spruce catch huge drifts of snow, which often remains until mid-summer. Stony land is used mainly for wildlife habitat, esthetics, and watershed. Capability unit VIIIs-1, dryland; not assigned to a range site or a woodland suitability group; windbreak suitability group 4.

Sunburst Series

The Sunburst series consists of deep, well-drained soils on uplands. These soils formed in glacial till. Elevation ranges from 3,400 to 4,300 feet. Slopes are 10 to 40 percent. The native vegetation is mainly western and thickspike wheatgrass, green needlegrass, and bluebunch wheatgrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is

39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown clay 6 inches thick. The underlying material is grayish-brown and light brownish-gray clay.

Permeability is slow. Available water capacity is high. Reaction is moderately alkaline. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Sunburst clay, steep, in native grass, 400 feet east and 100 feet south of the northwest corner of sec. 30, T. 32 N., R. 5 W.:

A1—0 to 6 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, very fine, granular structure; hard, friable, sticky and plastic; slight effervescence; moderately alkaline; clear, wavy boundary.

C1—6 to 13 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure that parts to moderate, medium angular blocks; very hard, friable, sticky and plastic; many, fine and very fine pores; many, fine and very fine roots; slight effervescence; few, soft vescence; moderately alkaline; clear, wavy boundary.

C2ca—13 to 26 inches, grayish-brown (2.5Y 5/2) clay, olive brown (2.5Y 4/4) moist; moderate, coarse, prismatic structure that parts to moderate, medium and coarse angular blocks; extremely hard, firm, sticky and plastic; many, fine pores; many, fine and very fine roots; slight effervescence; few soft masses and threads of lime; moderately alkaline; gradual, wavy boundary.

C3cacs—26 to 60 inches, light brownish-gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) moist; weak, medium and coarse, angular blocky structure in upper part and thick, platy structure in lower part; extremely hard, firm, sticky and plastic; few, fine and very fine pores and roots; few lignite chips, few small pebbles; slight effervescence; few, soft masses of lime and many masses and seams of gypsum; moderately alkaline.

In places there are a few cobbles and stones.

SU—Sunburst clay, steep (10 to 40 percent slopes). This soil is on uplands. Slopes are mainly 15 to 35 percent. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Kevin, Linnet, Pendroy, and Scobey soils. Also included are small areas of sandstone outcrop and landslip scars.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

This soil is suited to range. Capability unit VIe-1, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Swifton Series

The Swifton series consists of deep, well-drained soils on uplands and mountains. These soils formed in alluvium or glacial till. Elevation ranges from 4,600 to 6,500 feet. Slopes are 8 to 40 percent. The native vegetation is mainly lodgepole pine and Engelmann spruce. The mean annual precipitation is 20 to 35 inches, the mean annual air temperature is 34° to 38° F, and the growing season is 60 to 90 days.

In a representative profile 1½ inches of dark-colored

organic material overlies 3 inches of light-gray gravelly loam. Below this is pale-brown gravelly loam 19 inches thick. The next layer is light-gray and grayish-brown gravelly sandy clay loam 30 inches thick. The subsoil is yellowish-brown gravelly sandy clay loam.

Permeability is moderate. Available water capacity is moderate. Reaction is strongly acid or very strongly acid in the upper 37 inches, medium acid between depths of 37 and 52 inches, and mildly alkaline below a depth of 52 inches. Organic-matter content is low in the surface layer.

These soils are used mainly for woodland watershed.

Representative profile of Swifton gravelly loam in an area of Swifton-Garlet association, hilly, in woodland, 1,400 feet south and 1,600 feet west of the northeast corner of sec. 12, T. 31 N., R. 13 W.:

- O1—1½ inches to 0, undecomposed needles and matted dark-colored organic material.
- A21—0 to 3 inches, light-gray (10YR 7/2) gravelly loam, grayish brown (10YR 5/2) moist; weak, very thin, platy structure; soft, very friable, nonsticky and nonplastic; many, medium and fine roots; common, fine and few medium tubular pores; 20 percent pebbles; very strongly acid; clear, irregular boundary.
- A22—3 to 15 inches, pale-brown (10YR 6/3) gravelly loam, brown (10YR 4/3) moist; weak, fine and very fine, angular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many, medium and fine roots; few, fine, tubular pores; 20 percent pebbles; strongly acid; clear, smooth boundary.
- A23—15 to 22 inches, pale-brown (10YR 6/3) gravelly loam, dark grayish brown (10YR 4/2) moist; weak, medium and fine, angular blocky structure; hard, friable, slightly sticky and slightly plastic; common, fine and medium roots; few, fine, tubular pores; 20 percent pebbles; very strongly acid; clear, smooth boundary.
- A&B—22 to 37 inches, light-gray (10YR 7/2) and grayish-brown (10YR 5/2) gravelly light sandy clay loam, dark grayish brown (10YR 4/2) and brown (10YR 4/3) moist; moderate, medium, angular blocky structure; hard, friable, slightly sticky and slightly plastic; common, fine and medium roots; common, fine, tubular pores; common, light-gray clean silt and sand grains about 1 millimeter thick on peds; 25 percent pebbles; strongly acid; gradual, smooth boundary.
- B&A—37 to 52 inches, light-gray (10YR 7/2) gravelly sandy clay loam, dark grayish brown (10YR 4/2) moist; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, angular blocky structure; very hard, friable, sticky and plastic; few, fine roots; few, fine and large, tubular pores; light-gray clean silt and sand about 1 millimeter thick on peds; 30 percent pebbles; medium acid; clear, smooth boundary.
- B2t—52 to 72 inches, yellowish-brown (10YR 5/4) gravelly sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium and fine, angular blocky structure; very hard, friable, sticky and plastic; few, fine roots; few, fine and large, tubular pores; 40 percent pebbles and cobbles; common clay films on rock fragments, in pores, and along root channels; mildly alkaline.

The content of rock fragments ranges from 10 to 40 percent, by volume, throughout.

SV—Swifton-Mikesell association, hilly (8 to 35 percent slopes). This association is on uplands. It is about 60 percent Swifton gravelly loam and 30 percent Mikesell clay loam. Slopes are mainly 8 to 15 percent. Swifton and Mikesell soils have profiles similar to those described as representative of their respective series, but in some places the Swifton soil has clay below a depth of 4 feet.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are Mord and Nettleton soils in grassy parks and poorly drained soils in swales and closed basins.

Runoff is medium. The hazards of water erosion and soil blowing are slight or moderate.

The soils in this association are suited mainly to woodland and to use as watershed. Capability unit VIe-1, dryland; not assigned to a range site; Swifton part in woodland suitability group 5o1, and Mikesell part in woodland suitability group 5c1; windbreak suitability group 4.

SW—Swifton-Mord-Rock land association, very steep (15 to 70 percent slopes). This association is on uplands. It is about 35 percent Swifton gravelly loam, 35 percent Mord stony loam, and 30 percent Rock land. The Swifton soil has slopes mainly of 15 to 40 percent; slopes face north, east, and west. The Mord soil has slopes mostly of 15 to 35 percent that face south. Rock land has slopes of 35 to 70 percent. Rock land consists of hard sandstone or of limestone outcrops that are nearly barren of vegetation surrounded by shallow and very shallow soils.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

This association is mainly suited to woodland, watershed, and range. The vegetative cover is mainly lodgepole pine on the Swifton soil, scrubby trees and shrubs on the Rock land, and grass and a few areas of aspen on the Mord soil. Swifton and Mord parts in capability unit VIe-1, dryland, Rock land part in capability unit VIIIs-1, dryland; Mord part in Silty range site, 20- to 24-inch precipitation zone, Swifton and Rock land parts not assigned to a range site; Swifton part in woodland suitability group 5r1, Mord and Rock land parts not assigned to a woodland suitability group; windbreak suitability group 4.

SX—Swifton-Garlet association, hilly (8 to 35 percent slopes). This association is on mountains. It is about 70 percent Swifton gravelly loam and 25 percent Garlet stony loam. Slopes are mainly 8 to 15 percent. The Swifton soil is on side slopes, and the Garlet soil is on narrow ridgetops. The Swifton soil has the profile described as representative of the Swifton series. The Garlet soil has a profile similar to that described as representative of the Garlet series.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are Löberg soils and poorly drained soils.

Runoff is medium or rapid. The hazards of water erosion and soil blowing are slight or moderate.

The soils in this association are suited to woodland. Capability unit VIe-1, dryland, for both soils; not assigned to a range site; Swifton part in woodland suitability group 5o1, Garlet part in woodland suitability group 6x1; windbreak suitability group 4 for both soils.

Tally Series

The Tally series consists of deep, well-drained soils on uplands, outwash terraces, and lake terraces. These soils formed in alluvium from mixed sources. Elevation ranges from 3,600 to 4,300 feet. Slopes are 0 to 20 percent. The native vegetation is mainly prairie sand-

reed, needlethread, and some perennial forbs and woody plants. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is dark grayish-brown sandy loam 4 inches thick. The subsoil is dark-brown sandy loam 10 inches thick. The upper part of the substratum is brown and grayish-brown sandy loam 28 inches thick, and the lower part is light brownish-gray sand.

Permeability is moderately rapid in the upper 42 inches and very rapid below. Available water capacity is low or moderate. Reaction is neutral to a depth of 4 inches, mildly alkaline between depths of 10 and 14 inches, and moderately alkaline below a depth of 14 inches. Organic-matter content is medium or low in the surface layer.

These soils are used mainly for range. Many areas are also used for dryfarmed small grain and tame pasture.

Representative profile of Tally sandy loam, 0 to 2 percent slopes, in native grass, 60 feet north and 90 feet east of the center of sec. 13, T. 37 N., R. 6 W.:

- A11—0 to 1 inch, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; many, fine roots; neutral; abrupt, smooth boundary.
- A12—1 to 4 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very thin, platy structure; slightly hard, very friable, nonsticky and nonplastic; many, fine roots; neutral; clear, wavy boundary.
- B2—4 to 14 inches, dark-brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure that parts to moderate, medium angular blocks; hard, friable, nonsticky and nonplastic; common, fine roots; mildly alkaline; gradual, wavy boundary.
- C1ca—14 to 23 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, medium, prismatic structure; hard, very friable, nonsticky and nonplastic; common, fine roots; strong effervescence; a few masses of white segregated lime; moderately alkaline; gradual, smooth boundary.
- C2ca—23 to 42 inches, grayish-brown (10YR 5/2) light sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few, fine roots; strong effervescence; masses of white segregated lime, lime crusts on sands and pebbles; moderately alkaline; diffuse, irregular boundary.
- C3—42 to 76 inches, light brownish-gray (10YR 6/2) sand, dark brown (10YR 4/3) moist; massive; loose, nonsticky and nonplastic; few, fine roots; strong effervescence; thin lime coatings on some pebbles and sand grains; moderately alkaline.

The depth to calcareous material ranges from 12 to 20 inches. Lime in the Cca horizon ranges from a few to many fine threads and masses.

Ta—Tally sandy loam, 0 to 2 percent slopes. This nearly level soil is on outwash terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Attewan and Yetull soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to small grain, tame pasture, and range. Capability unit IIIe-4, dryland; Sandy range site, 12- to 14-inch precipitation zone; not as-

signed to a woodland suitability group; windbreak suitability group 2M.

Tb—Tally sandy loam, undulating (2 to 8 percent slopes). This soil is on outwash terraces and lake terraces. Slopes are mainly 2 to 4 percent.

Included with this soil in mapping are a few small areas of Yetull fine sand.

Runoff is slow or medium. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is well suited to small grain, tame pasture, and range. Capability unit IIIe-4, dryland; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Tc—Tally sandy loam, rolling (4 to 15 percent slopes). This soil is on uplands. Slopes are mainly 4 to 8 percent.

Included with this soil in mapping are a few small areas of Yetull fine sand. Also included are small areas of Scobey and Arnegard soils.

Runoff is medium. The hazard of water erosion is moderate. The hazard of soil blowing is severe, mainly because the included Yetull fine sand is a source of abrading sand.

This soil is well suited to dryfarmed small grain, tame pasture, and range. Capability unit IIIe-4, dryland; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

TD—Tally complex, sloping (4 to 20 percent slopes). This complex is on outwash terraces. It is about 60 percent Tally sandy loam and 30 percent eroded Tally soils. Slopes are mainly 4 to 8 percent.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are shale and sandstone outcrop.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Tanna Series

The Tanna series consists of moderately deep, well-drained soils on uplands. These soils formed in material weathered from shale. Elevation ranges from 3,800 to 4,400 feet. Slopes are 2 to 15 percent. The native vegetation is green needlegrass, western and thickspike wheatgrass, and bluebunch wheatgrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is grayish-brown clay loam 7 inches thick. The subsoil is grayish-brown silty clay in the upper 7 inches and light brownish-gray clay loam in the lower 10 inches. The substratum is light brownish-gray heavy clay loam 14 inches thick. Soft, platy shale is at a depth of 38 inches.

Permeability is slow. Available water capacity is low to moderate. Reaction is mildly alkaline to a depth of

14 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed small grain, tame pasture, and range.

Representative profile of Tanna clay loam, 2 to 4 percent slopes, in a cultivated field, 2,600 feet east and 60 feet north of the southwest corner of sec. 1, T. 35 N., R. 6 W.:

Ap—0 to 7 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, granular structure, many surface clods; slightly hard, friable, sticky and plastic; mildly alkaline; abrupt, smooth boundary.

B2t—7 to 14 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure that parts to strong, fine subangular blocks; very hard, friable, very sticky and very plastic; thin, discontinuous clay films on pedis; mildly alkaline; clear, irregular boundary.

B3ca—14 to 24 inches, light brownish-gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; weak, medium, prismatic structure; hard, friable, sticky and plastic; dark staining on prisms; strong effervescence; moderately alkaline; gradual, smooth boundary.

C1ca—24 to 38 inches, light brownish-gray (2.5Y 6/2) heavy clay loam, light olive brown (2.5Y 5/4) moist; massive, with weak, platy rock structure; hard, friable, sticky and plastic; segregated lime in a violently effervescent matrix; moderately alkaline; gradual, wavy boundary.

C2—38 to 60 inches, soft, platy shale.

The depth to calcareous material ranges from 8 to 15 inches. The depth to shale ranges from 30 to 40 inches.

Te—Tanna clay loam, 2 to 4 percent slopes. This gently sloping soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have slopes of 4 to 8 percent. Also included are a few small areas of Boxwell soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain and tame pasture. It is also suited to range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Tf—Tanna clay loam, 4 to 8 percent slopes. This rolling soil is on shale uplands. It has a profile similar to that described as representative of the series, but depth to calcareous material ranges from 8 to 15 inches.

Included with this soil in mapping are small areas of soils that have slopes of 2 to 4 percent. A few small areas of Wayden soils are also included.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Tg—Tanna-Absher clay loams (0 to 4 percent slopes). This complex of nearly level and gently sloping soils is on foot slopes and in broad swales on uplands. It is about 75 percent Tanna clay loam and 15 percent Absher clay loam. The pattern of soils is very

complex, and the Absher soil occurs at random throughout the mapping unit.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are Wayden and Ethridge soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are suited to dryfarmed small grain, tame pasture, and range. Capability unit IIIe-3, dryland; Tanna part in Clayey range site, 12- to 14-inch precipitation zone, Absher part in Dense Clay range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Tanna part in windbreak suitability group 2M, Absher part in windbreak suitability group 4.

Th—Tanna-Wayden clay loams, rolling (4 to 15 percent slopes). This complex is on uplands. It is about 70 percent Tanna clay loam and 30 percent Wayden clay loam. Slopes are mainly 4 to 8 percent. Tanna clay loam is mainly on foot slopes, and Wayden clay loam is on ridges, hilltops, and south-facing slopes. The Tanna soil has a profile similar to that described as representative of the Tanna series, but the depth to calcareous material ranges from 8 to 15 inches. The Wayden soil has a profile similar to that described as representative of the Wayden series.

Included with these soils in mapping are a few small areas of hard shale outcrop. Also included are a few small areas of slowly permeable claypan soils and small areas of deep clay loams.

Runoff is medium or rapid. The hazard of water erosion is moderate or severe, and the hazard of soil blowing is moderate.

The soils in this complex are suited to dryfarmed small grain, tame pasture, and range. Capability unit IVE-3, dryland; Tanna part in Clayey range site, 12- to 14-inch precipitation zone, Wayden part in Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Tanna part in windbreak suitability group 2M, Wayden part in windbreak suitability group 3M.

Tenex Series

The Tenex series consists of deep, well-drained soils on hills and foot slopes of the mountains. These soils formed in coarse glacial till. Elevation ranges from 4,800 to 5,800 feet. Slopes are 4 to 15 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, and alpine fir and an understory of shrubs and forbs. The mean annual precipitation is 20 to 35 inches, the mean annual air temperature is 34° to 38° F, and the growing season is 60 to 90 days.

In a representative profile there is a layer of forest litter 1½ inches thick on the surface. The surface layer is light-gray sandy loam ½ inch thick. The upper part of the subsoil is pale-brown cobbly loam 4 inches thick, the middle part is light yellowish-brown cobbly light clay loam 19 inches thick, and the lower part is light yellowish-brown very gravelly sandy loam 28 inches thick. The substratum is light yellowish-brown very gravelly and cobbly sandy loam.

Permeability is moderate to a depth of 23 inches and moderately rapid below that depth. Available water capacity is low. Reaction is very strongly acid to a

depth of 51 inches and medium acid below that depth. Organic-matter content is low in the surface layer.

This soil is used mainly for woodland.

Representative profile of Tenex cobbly loam, hilly, in woodland, 2,640 feet north and 1,188 feet east of the southwest corner of sec. 20, T. 34 N., R. 13 W.:

- O1—1½ inches to 1 inch, black, partially decomposed organic layer of conifer needles and leaves of other forest plants; slightly hard.
- O2—1 inch to 0, black, highly decomposed organic layer; slightly hard; very strongly acid.
- A2—0 to ½ inch, light-gray (10YR 7/1) sandy loam, gray (10YR 5/1) moist; very strongly acid; abrupt, broken boundary.
- B1—½ inch to 4 inches, pale-brown (10YR 6/3) cobbly loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many roots; 25 percent cobbles and pebbles; very strongly acid; clear, wavy boundary.
- B21ir—4 to 11 inches, light yellowish-brown (10YR 6/4) cobbly light clay loam, dark yellowish brown (10YR 4/4) moist; moderate, fine and medium, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; 30 percent cobbles and pebbles; very strongly acid; gradual, wavy boundary.
- B22ir—11 to 23 inches, light yellowish-brown (10YR 6/4) cobbly light clay loam, yellowish brown (10YR 5/4) moist; moderate, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common roots; 45 percent cobbles; very strongly acid; gradual, wavy boundary.
- IIB3—23 to 51 inches, light yellowish-brown (10YR 6/4) very gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak, fine, angular blocky structure; soft, very friable, nonsticky and slightly plastic; few roots; very pale brown (10YR 7/3) coatings on peds; 70 percent pebbles; very strongly acid; gradual, wavy boundary.
- IIC—51 to 70 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, nonsticky and slightly plastic; few roots; 65 percent pebbles; coatings of very pale brown (10YR 7/3); medium acid, but small areas of high chroma (probably limestone remnants) are moderately alkaline.

The O horizon is 1 to 3 inches thick and is underlain by a discontinuous A2 horizon that ranges from 0 to 2 inches in thickness. To a depth of 23 inches, content of rock fragments ranges from 25 to 45 percent, by volume, and below this depth it ranges from 50 to 70 percent.

TK—Tenex cobbly loam, hilly (4 to 15 percent slopes). This soil is on hills and foot slopes along the mountains. Slopes are mainly 8 to 15 percent.

Included with this soil in mapping are small areas of soils that have slopes somewhat greater than 15 percent. Also included are a few small areas of seeps and narrow wet drainageways and small areas of Sherburne, Loberg, and Leavitt soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

This soil is suited mainly to woodland. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 601; windbreak suitability group 2M.

Terrace Escarpments and Fairfield Soils

TL—Terrace escarpments and Fairfield soils (10 to 40 percent slopes). This undifferentiated group is extensive and has many small and large delineations. It consists of moderately steep to very steep soils. The

relief of the escarpment ranges from about 20 to 150 feet. The topography is even slopes of terrace fronts, which may extend for several miles, or it is terrace edges dissected by many small drainageways that have slopes of various gradients and exposures. The most common soils in this group are Fairfield soils. Elevation ranges from 3,600 to 4,700 feet. The main vegetation is bluebunch wheatgrass, western wheatgrass, and needleandthread. The annual precipitation is 12 to 15 inches, and the frost-free season is 85 to 110 days.

The sequence of materials underlying the terraces and in some places exposed by escarpments commonly is as follows: The upper 5 to 10 feet is loam or clay loam underlain by calcareous loose gravel and sand or very gravelly clay loam sediment. At a depth of 5 to 30 feet the alluvial material is underlain by shale or sandstone. The bedrock outcrops on the escarpments in places. The exposed gravel near the top of the slopes sloughs off and mantels most of the lower slopes. In many places there are massive landslips.

Included in mapping are Arnegard, Castner, Cabba, and Wayden soils. Arnegard soils are mainly in narrow drainageways. Castner, Cabba, and Wayden soils are on the lower parts of the escarpments and are associated with the sandstone and shale outcrop. Also included are common hillside seeps and wet, narrow draws, especially west of Cut Bank where the areas above the escarpments are irrigated.

Runoff is medium to very rapid. The hazard of water erosion is moderate or severe. There is a hazard of soil blowing on the south- and southwest-facing side slopes.

These soils are used mainly for range. There are a few small nearly barren areas of loose gravel, shale, and sandstone, but most of these areas are well vegetated. There are a few soils within areas of better soils that are being used for grain and tame pasture, but most areas are not suited to cultivated crops. Where irrigated, a few areas of escarpments are used for hay and pasture for convenience of ditch layout or to make use of irrigation waste water. Capability unit VIe-1, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Thebo Series

The Thebo series consists of moderately deep, well-drained soils on uplands. These soils formed in material weathered from clay shale. Elevation ranges from 4,000 to 4,600 feet. Slopes are 2 to 8 percent. The native vegetation is mainly western and thickspike wheatgrass, green needlegrass, bluebunch wheatgrass, and some perennial forbs. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is gray and olive-gray clay 5 inches thick. The upper part of the substratum is gray and olive clay 17 inches thick, and the lower part is pale-olive light clay 10 inches thick over shale.

Permeability is very slow. Available water capacity is low or moderate. Reaction is neutral and mildly alkaline in the upper 5 inches, moderately alkaline between depths of 5 and 14 inches, strongly alkaline between depths of 14 and 22 inches, and moderately

alkaline below a depth of 22 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed small grain, tame pasture, and range.

Representative profile of Thebo clay, undulating, in native grass, 60 feet north and 800 feet west of the center of sec. 20, T. 36 N., R. 8 W.:

- A11—0 to 1 inch, gray (5Y 6/1) clay, dark grayish brown (2.5Y 4/2) moist; strong, very fine, granular structure; slightly hard, friable, sticky and plastic; neutral; abrupt, smooth boundary.
- A12—1 to 5 inches, olive-gray (5Y 5/2) heavy clay, dark grayish brown (2.5Y 4/2) moist; strong, medium, angular blocky structure; very hard, very firm, sticky and very plastic; mildly alkaline; clear, smooth boundary.
- C1—5 to 14 inches, gray (5Y 5/1) heavy clay, olive gray (5Y 4/2) moist; weak, coarse, angular blocky structure; major vertical cracks 10 to 14 inches apart; extremely hard, very firm, very sticky and very plastic; moderately alkaline; clear, irregular boundary.
- C2ca—14 to 22 inches, olive (5Y 5/3) clay, dark gray (5Y 4/1) moist; moderate, coarse, angular blocky structure; very hard, firm, sticky and plastic, common coarse, prominent mottles of lime; strongly alkaline; clear, irregular boundary.
- C3cs—22 to 32 inches, pale-olive (5Y 6/3) light clay, olive (5Y 5/3) moist; weak, coarse, angular blocky structure; hard, firm, sticky and plastic; many, fine, distinct mottles of gypsum; a few, hard shale chips; moderately alkaline; clear, irregular boundary.
- C4—32 to 54 inches, shale.

Depth to soft shale ranges from 30 to 40 inches.

Tm—Thebo clay, undulating (2 to 8 percent slopes). This soil is on uplands. Slopes are mainly 2 to 4 percent.

Included with this soil in mapping are a few small areas of Shale outcrop and clay soils that are shallow over shale. Also included are small areas of soils that have somewhat greater slopes and small areas of Pendroy soils.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate.

This soil is suited to range. It is less well suited to small grain and tame pasture. Capability unit IIIe-3, dryland; Clayey range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Timberg Series

The Timberg series consists of moderately deep, well-drained soils on uplands. These soils formed in material weathered from light-red shale. Elevation ranges from 4,200 to 4,800 feet. Slopes are 2 to 8 percent. The native vegetation is mainly rough fescue, western and thickspike wheatgrass, and Columbia and green needlegrass. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is brown clay loam 7 inches thick. The subsoil is reddish-brown clay loam and silty clay 14 inches thick. The substratum is reddish-brown silty clay 11 inches thick over light-red shale.

Permeability is moderately slow. Available water capacity is low or moderate. Reaction is neutral in the

upper 7 inches, mildly alkaline between depths of 7 and 12 inches, moderately alkaline between depths of 12 and 32 inches, and strongly alkaline below a depth of 32 inches. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed small grain, tame pasture, and range.

Representative profile of Timberg clay loam, undulating, in a cultivated field, 1,600 feet north and 900 feet west of the southeast corner of sec. 18, T. 35 N., R. 10 W.:

- Ap—0 to 7 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate, very fine, crumb structure; slightly hard, friable, sticky and slightly plastic; neutral; abrupt, smooth boundary.
- B2—7 to 12 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate, medium, prismatic structure that parts to moderate, medium subangular blocks; hard, friable, sticky and slightly plastic; slight effervescence; mildly alkaline; gradual, irregular boundary.
- B3ca—12 to 21 inches, reddish-brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) moist; weak, medium, prismatic structure that parts to weak, medium subangular blocks; very hard, friable, sticky and slightly plastic; strong effervescence; a few nodules and threads of segregated lime; moderately alkaline; gradual, irregular boundary.
- C1ca—21 to 32 inches, reddish-brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) moist; massive; very hard, firm, sticky and plastic; strong effervescence; many nodules of pinkish-white (5YR 8/2) lime; moderately alkaline; clear, wavy boundary.
- IIC2—32 to 60 inches, light-red (2.5YR 6/6) shale, reddish brown (5YR 4/3) moist; strong effervescence; strongly alkaline.

The A horizon ranges from brown to reddish brown. The B horizon ranges from clay loam to silty clay. The depth to shale ranges from 30 to 40 inches.

Tn—Timberg clay loam, undulating (2 to 8 percent slopes). This soil is on uplands. Slopes are mainly 2 to 4 percent.

Included with this soil in mapping are a few small areas of Litimber soils in narrow drainageways and Kuro soils on knolls and ridges. Also included are small areas of very slowly permeable claypan soils.

Runoff is medium. The hazards of water erosion and soil blowing are moderate.

This soil is suited to dryfarmed small grain, tame pasture, and range. Capability unit IIIe-2, dryland; Clayey range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 2M.

Tinsley Series

The Tinsley series consists of deep, excessively drained soils on terraces. These soils formed in alluvium. Elevations range from 4,200 to 4,800 feet. Slopes are 0 to 2 percent. The native vegetation is mainly blue-bunch wheatgrass, rough fescue, and some perennial forbs. The mean annual precipitation is 14 to 20 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 105 days.

In a representative profile the surface layer is grayish-brown gravelly sandy loam 4 inches thick. The underlying material is grayish-brown very gravelly loamy sand or sand.

Permeability is rapid. Available water capacity is

very low. Reaction is neutral. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Tinsley gravelly sandy loam in an area of Tinsley soils in native grass, 600 feet north and 300 feet west of the center of sec. 7, T. 33 N., R. 10 W.:

- A1—0 to 4 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very thin, platy structure; soft, very friable, nonsticky and nonplastic; 40 percent pebbles, cobbles, and stones; neutral; clear, smooth boundary.
- C1—4 to 12 inches, grayish-brown (2.5Y 5/2) very gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grained; 60 percent pebbles; gradual, smooth boundary.
- C2—12 to 60 inches, very gravelly sand; 70 percent pebbles and cobbles; much of the medium and coarse sand is red, green, and brown argillite and quartzite; neutral.

The A1 horizon is gravelly, cobbly, or very gravelly sandy loam or loam and ranges from 2 to 8 inches in thickness. The content of rock fragments ranges from 40 to 90 percent, by volume, throughout.

TN—Tinsley soils (0 to 2 percent slopes). This undifferentiated group of nearly level soils is on stream terraces. It consists of Tinsley gravelly sandy loam, Tinsley cobbly sandy loam, and Tinsley very gravelly sandy loam.

Included with these soils in mapping are a few small areas of recent gravel overwash.

Runoff is very slow. The hazards of water erosion and soil blowing are slight or moderate.

These soils are suited to range. Capability unit VIIIs-1, dryland; Gravel range site, 15- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Turner Series

The Turner series consists of deep, well-drained soils on fans and terraces. These soils formed in alluvium. Elevation ranges from 4,000 to 4,600 feet. Slopes are 0 to 4 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, and western and thick-spike wheatgrass. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is dark grayish-brown cobbly loam 4 inches thick. The subsoil is dark-brown clay loam 8 inches thick. The upper part of the substratum is grayish-brown loam 14 inches thick, the middle part is grayish-brown very cobbly loamy sand 14 inches thick, and the lower part is very gravelly sand.

Permeability is moderate in the upper 26 inches, moderately rapid between depths of 26 and 40 inches, and very rapid below a depth of 40 inches. Available water capacity is low. Reaction is neutral in the upper 12 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for dryfarmed and irrigated small grain, tame pasture, irrigated alfalfa hay, and range.

Representative profile of Turner cobbly loam, 0 to 4

percent slopes, in native grass, 200 feet west and 900 feet north of the southeast corner of sec. 15, T. 33 N., R. 10 W.:

- A1—0 to 4 inches, dark grayish-brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; moderate, very fine, crumb and angular blocky structure; soft, very friable, slightly sticky and slightly plastic; 20 percent cobbles and pebbles; neutral; clear, wavy boundary.
- B2t—4 to 12 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, fine, angular blocky structure; hard, friable, sticky and plastic; moderately thick, very dark grayish-brown (10YR 3/2) clay films on ped; 10 percent pebbles and cobbles; neutral; clear, wavy boundary.
- C1ca—12 to 26 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure; hard, very friable, slightly sticky and slightly plastic; 15 percent pebbles and cobbles; strong effervescence; many, fine, white lime masses; moderately alkaline; gradual, wavy boundary.
- IIC2ca—26 to 40 inches, grayish-brown (2.5Y 5/2) very cobbly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grained; firm in place; 60 percent cobbles and pebbles; strong effervescence; lime cementation on pebbles; moderately alkaline; gradual, wavy boundary.
- IIC3—40 to 60 inches, loose, very gravelly sand; moderately alkaline.

The A1 horizon is loam, cobbly loam, or gravelly loam and ranges from 2 to 5 inches in thickness. The depth to calcareous material ranges from 10 to 18 inches. To a depth of 26 inches, content of rock fragments ranges from 0 to 20 percent, by volume; between depths of 26 and 40 inches, it ranges from 40 to 60 percent; and below a depth of 40 inches, it ranges from 50 to 75 percent.

To—Turner loam, 0 to 4 percent slopes. This nearly level to gently sloping soil is on terraces. It has a profile similar to that described as representative of the series, but the surface layer is loam.

Included with this soil in mapping are a few small areas of Beaverton gravelly loam.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain and tame pasture. It is also suited to range and irrigated hay. Capability units IIIe-4, dryland, and IIIs-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Tr—Turner cobbly loam, 0 to 4 percent slopes. This nearly level or gently sloping soil is on alluvial fans or terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Turner loam and Beaverton gravelly loam.

Runoff is slow or medium. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed and irrigated small grain and tame pasture. It is also suited to range and irrigated hay. Capability units IIIe-4, dryland, and IIIs-1, irrigated; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Ts—Turner-Beaverton loams, 0 to 4 percent slopes. This complex of nearly level or gently sloping soils is on fans and terraces. It consists of Turner loam and Beaverton loam. These soils have profiles similar to

those described as representative of their respective series, but the surface layer is loam.

Included with these soils in mapping are a few small areas of Williams soils.

Runoff is slow or medium. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

These soils are suited to range and to tame pasture. Capability unit IVs-1, dryland; Turner part in Silty range site, 12- to 14-inch precipitation zone, Beaverton part in Shallow to Gravel range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Utica Series

The Utica series consists of deep, excessively drained soils on terraces and fans. These soils formed in very gravelly alluvium from mixed sources, but mainly from limestone. Elevation ranges from 3,800 to 4,600 feet. Slopes are 0 to 4 percent. The native vegetation is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, forbs, and some shrubs. The mean annual precipitation is 16 to 21 inches, and the frost-free season is 85 to 110 days.

In a representative profile the upper part of the surface layer is dark-brown and dark grayish-brown very gravelly sandy loam 5 inches thick, and the lower part is dark grayish-brown very gravelly sandy loam 10 inches thick. The underlying material is white and light brownish-gray very gravelly sand.

Permeability is rapid. Available water capacity is very low. Reaction is mildly alkaline to a depth of 5 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for range.

Representative profile of Utica very gravelly sandy loam in native grass, 900 feet west and 400 feet south of the center of sec. 20, T. 31 N., R. 8 W.:

- A11—0 to 2 inches, dark grayish-brown (10YR 4/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, crumb structure; soft, very friable, slightly sticky and slightly plastic; 60 percent pebbles and cobbles; mildly alkaline; abrupt, smooth boundary.
- A12—2 to 5 inches, dark-brown (10YR 3/3) very gravelly sandy loam, same color moist; moderate, very fine, crumb structure; soft, very friable, nonsticky and slightly plastic; 60 percent pebbles and cobbles; slight effervescence; mildly alkaline; clear, smooth boundary.
- A13—5 to 15 inches, dark grayish-brown (10YR 4/2) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak, very fine, crumb structure; soft, very friable, nonsticky and nonplastic; 60 percent pebbles and cobbles; strong effervescence; lime coats only on lower parts of pebbles; moderately alkaline; clear, smooth boundary.
- C1ca—15 to 18 inches, white (10YR 8/2) very gravelly sandy loam, very pale brown (10YR 7/3) moist; massive; hard, firm, nonsticky and nonplastic; 75 percent pebbles; strong effervescence; moderately alkaline; abrupt, wavy boundary.
- C2ca—18 to 35 inches, light brownish-gray (10YR 6/2) very gravelly sand, grayish brown (10YR 5/2) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; 75 percent pebbles; strong effervescence; thick lime coats on pebbles; moderately alkaline; gradual, smooth boundary.
- C3ca—35 to 60 inches, light brownish-gray (10YR 6/2) very gravelly sand, grayish brown (10YR 5/2) moist;

single grained; loose, nonsticky and nonplastic; 75 percent pebbles; strong effervescence; thin lime coats on pebbles; moderately alkaline.

To a depth of 18 inches, content of rock fragments ranges from 45 to 65 percent, by volume, and below this depth, it ranges from 70 to 80 percent.

Ua—Utica very gravelly sandy loam (0 to 4 percent slopes). This nearly level or gently sloping soil is on terraces and fans.

Included with this soil in mapping are a few small areas of Kiwanis and Kiev soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

This soil is suited to range. Capability unit VI_s-1, dryland; Shallow to Gravel range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Vanda Series

The Vanda series consists of deep, well-drained soils on valley bottoms, low terraces, and basins. These soils formed in alluvium from sedimentary rock. Elevation ranges from 3,600 to 4,200 feet. Slopes are 0 to 4 percent. The native vegetation is mainly western and thickspike wheatgrass, green needlegrass, greasewood, winterfat, and Nuttall's saltbush. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 110 days.

In a representative profile the surface layer is light brownish-gray clay 5 inches thick. The next layer is light olive-gray clay 4 inches thick. The underlying material is light olive-gray clay.

Permeability is very slow. Available water capacity is moderate or high. Reaction is moderately alkaline. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Vanda clay in native grass, 1,140 feet east and 300 feet north of center of sec. 29, T. 31 N., R. 6 W.:

- A2—0 to ½ inch, gray (5Y 6/1) silty clay, olive gray (5Y 5/2) moist; vesicular crust; hard, friable, sticky and plastic; strong effervescence; moderately alkaline; abrupt, smooth boundary.
- AC1—½ inch to 1½ inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; strong, very fine, granular structure; hard, friable, sticky and plastic; common, very fine roots; strong effervescence; moderately alkaline; abrupt, smooth boundary.
- AC2—1½ to 5 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate, fine, subangular blocky structure; very hard, firm, sticky and plastic; common, very fine roots; strong effervescence; moderately alkaline; clear, smooth boundary.
- AC3—5 to 9 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; weak, medium, prismatic structure that parts to moderate, fine and medium angular blocks; very hard, very firm, very sticky and very plastic; common, very fine roots; prisms coated with grayish brown (2.5Y 5/2), dark grayish brown (2.5Y 4/2) moist; strong effervescence; moderately alkaline; gradual, smooth boundary.
- C1ca—9 to 14 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; grayish-brown (2.5Y 5/2) coats, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure that parts to moderate, fine and medium angular blocks; very hard, very firm, very sticky and very plastic; common,

very fine roots; strong effervescence; a few nodules of segregated lime; strongly alkaline; gradual, smooth boundary.

C2c_{ss}a—14 to 48 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; massive; very hard, very firm, very sticky and very plastic; few roots; very fine nodules of white salts and gypsum; strong effervescence; moderately alkaline; gradual, smooth boundary.

C3—48 to 60 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 5/2 and 4Y 4/2) moist; massive; very hard, firm, very sticky and very plastic; very few roots; strong effervescence; moderately alkaline.

The A2 horizon ranges from ½ to 3 inches in thickness. Content of exchangeable sodium in the upper 15 to 20 inches ranges from 10 to 20 percent. Below a depth of 20 inches content of exchangeable sodium ranges from 20 to 40 percent.

Va—Vanda clay (0 to 4 percent slopes). This soil is nearly level or gently sloping.

Included with this soil in mapping are a few small areas of Pendroy and Dimmick soils.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or severe.

This soil is suited to range. Capability unit VI_s-1, dryland; Dense Clay range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Wayden Series

The Wayden series consists of shallow, excessively drained soils on uplands. These soils formed in material weathered from shale. Elevation ranges from 3,600 to 4,600 feet. Slopes are 2 to 50 percent. The native vegetation is mainly bluebunch wheatgrass, western and thickspike wheatgrass, and needleandthread. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 110 days.

In a representative profile the surface layer is grayish-brown clay loam 6 inches thick. The underlying material is light brownish-gray and light-gray silty clay 12 inches thick and light olive-gray shale.

Permeability is slow. Available water capacity is very low or low. Reaction is mildly alkaline to a depth of 6 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed small grain and tame pasture.

Representative profile of Wayden clay loam, undulating, in native grass, 2,000 feet north and 400 feet west of the southeast corner of sec. 35, T. 37 N., R. 7 W.:

A11—0 to 2 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, very fine, granular structure; loose, very friable, nonsticky and plastic; mildly alkaline; abrupt, smooth boundary.

A12—2 to 6 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure that parts to weak, thin plates; slightly hard, friable, slightly sticky and plastic; mildly alkaline; clear, smooth boundary.

C1c_a—6 to 13 inches, light brownish-gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak, medium, prismatic structure that parts to weak, fine angular blocks; extremely hard, friable, sticky and plastic; strong effervescence; common lime

nodules; moderately alkaline; clear, irregular boundary.

C2c_a—13 to 18 inches, light-gray (5Y 7/1) silty clay, light brownish gray (2.5Y 6/2) moist; weak, coarse, prismatic structure that parts to weak, coarse angular blocks; extremely hard, firm, sticky and plastic; strong effervescence; common lime nodules; moderately alkaline; gradual, wavy boundary.

C3—18 to 60 inches, light olive-gray (5Y 6/2) shale; strong effervescence; moderately alkaline.

Depth to underlying shale ranges from 10 to 20 inches.

Wa—Wayden clay loam, undulating (2 to 8 percent slopes). This soil is on smooth, undissected uplands. Slopes are mainly 2 to 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Shale outcrop. Small areas of Tanna clay loam in swales and on foot slopes are also included.

Runoff is slow or medium. The hazard of water erosion is moderate, and the hazard of soil blowing is severe.

This soil is suited mainly to range. It is suited to dryfarmed small grain and tame pasture. Capability unit IV_s-2, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Wb—Wayden clay loam, hilly (8 to 35 percent slopes). This soil is on dissected shale uplands. Slopes are mainly 8 to 15 percent.

Included with this soil in mapping are small areas of Tanna clay loam in swales and on foot slopes. Also included are a few small areas of barren shale or sandstone outcrop and small areas of Cabba and Boxwell soils.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

This soil is suited mainly to range. Capability unit VI_e-1, dryland; Shallow range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Wc—Wayden-Absher complex, undulating (2 to 6 percent slopes). This complex is on uplands. It is about 70 percent Wayden clay loam and 30 percent Absher loam and clay loam. Slopes are mainly 2 to 4 percent. Wayden clay loam is on broad ridges and hills, and Absher loam and clay loam are mainly along small drainageways.

Included with these soils in mapping are small wet spots and areas of nearly barren clay. Small areas of deep soil similar to Tanna clay loam are also included.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited mainly to range. Capability unit VI_s-1, dryland; Wayden part in Shallow range site, 12- to 14-inch precipitation zone, Absher part in Dense Clay range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; Wayden part in windbreak suitability group 3M, Absher part in windbreak suitability group 4.

WD—Wayden-Shale outcrop complex, steep (10 to 50 percent slopes). This complex is on uplands. It is about 60 percent Wayden clay loam and 30 percent nearly barren Shale outcrop. Slopes are mainly 15 to

35 percent. The pattern of soil is very complex, and small areas of Shale outcrop occur throughout the mapping unit. Shale outcrop is mainly gray shale, but in places there are small ledges of hard sandstone.

Included in mapping are 10 percent deep and moderately deep loam and clay loams, mainly Tanna clay loam, in swales and on foot slopes. In T. 35 N., R. 10 and 11 W., there is about 1,100 acres included in this mapping unit that has red shale material. This area is mainly Kuro soils rather than Wayden soils, and the Litimber and Timberg clay loams are included. These areas are used and managed similarly to the rest of the mapping unit.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate or severe.

The soils in this complex are suited mainly to range. Areas of Shale outcrop provide little or no usable forage. Capability unit VIIs-1, dryland; Wayden part in Shallow range site, 12- to 14-inch precipitation zone, Shale outcrop part not assigned to a range site; not assigned to a woodland suitability group; windbreak suitability group 4.

Wet Alluvial Land

WE—Wet alluvial land (0 to 2 percent slopes). This land type consists of very poorly drained and poorly drained soils along the major streams. Areas of these soils are commonly 10 to 40 acres but range from 5 to 200 acres in size. Most of the soils in this land type are loam or sandy loam 20 to 40 inches thick over sand and gravel. The surface layer is moist throughout the growing season in most years and is very wet in spring. Some flooding occurs in addition to a high water table. The soil is mildly calcareous throughout, but salt accumulation is not a serious problem. An organic root mat 1 inch to 3 inches thick is on the surface in most places.

Most areas of these soils are in pasture or are cut for native hay. Some areas can be drained and are suited to crops. Additional soil studies should be made if drainage and cultivation are considered. Capability unit Vw-1, dryland; Wet Land range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Wet Land

WF—Wet land (0 to 20 percent slopes). This land type consists of seeps and poorly drained soils mainly on uplands. The supplemental water is from underground seepage rather than from flooding along active streams. Areas of these soils range from 5 acres to several hundred acres in size. Most areas of these soils are gently sloping in swales, basins, and drainageways, but steep sidehill seep areas are also common. The soils are mostly deep loam or clay loam. The surface layer is dark colored. Lime accumulations are common in the subsoil.

Depth to the water table varies greatly, as does its persistence. The surface layer is generally very wet in the spring but is dry by late summer in most years. Some of these soils remain very wet throughout the year.

These soils are used mainly for grazing, although many areas are cut for hay. A few areas have been seeded. Many areas of this land type can be drained and are suited to tame pasture, hay, or crops. Further soil investigations should be made where there is interest in developing these soils. Capability unit Vw-1, dryland; Subirrigated range site, 12- to 19-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Whitore Series

The Whitore series consists of deep, somewhat excessively drained soils on mountains and uplands. These soils formed in glacial till or colluvium derived mainly from limestone. Elevation ranges from 4,500 to 6,500 feet. Slopes are 2 to 60 percent. The native vegetation is mainly limber pine, aspen, and lodgepole pine, or rough fescue and bluebunch wheatgrass in the open park areas. The mean annual precipitation is mainly 15 to 20 inches but ranges to about 35 inches. The mean annual air temperature is 34° to 38° F, and the growing season is 60 to 90 days.

In a representative profile dark-colored forest litter of decomposing leaves, needles, and twigs 1 inch thick is on the surface. The surface layer is dark-gray cobbly loam 2 inches thick. The subsoil is brown cobbly clay loam 5 inches thick. The substratum is light-gray cobbly loam and light olive-gray cobbly clay loam and cobbly heavy loam.

Permeability is moderate. Available water capacity is low. Reaction is neutral to a depth of 7 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for woodland and grazeable woodland.

Representative profile of Whitore cobbly loam in an area of Whitore complex, rolling, in woodland, 100 feet south and 100 feet west of the northeast corner of sec. 6, T. 28 N., R. 9 W.:

- O1&O2—1 inch to 0, black (10YR 2/1) forest litter of undecomposed and partly decomposed needles and twigs, with charcoal, black (10YR 2/1) moist; loose; 25 percent cobbles; neutral; abrupt, smooth boundary.
- A1—0 to 2 inches, dark-gray (10YR 4/1) cobbly loam, very dark gray (10YR 3/1) moist; weak, medium, angular blocky structure that parts to weak, thin plates; slightly hard, very friable, nonsticky and nonplastic; 25 percent cobbles; common fragments of charcoal; neutral; abrupt, smooth boundary.
- B2—2 to 7 inches, brown (10YR 5/3) cobbly clay loam, dark grayish brown (10YR 4/2) moist; moderate, fine and very fine, subangular blocky structure; hard, firm, sticky and plastic; dark-brown (10YR 3/3) and very dark grayish-brown (10YR 3/2) ped coatings; 25 percent cobbles and stones; neutral; clear, irregular boundary.
- C1ca—7 to 19 inches, light-gray (10YR 7/2) cobbly loam, grayish brown (10YR 5/2) moist; weak, medium and thick, platy structure; hard, firm, sticky and plastic; 35 percent cobbles and stones; strong effervescence; lime disseminated through the soil, lime crusts on rock fragments; moderately alkaline; gradual, wavy boundary.
- C2ca—19 to 41 inches, light olive-gray (5Y 6/2) cobbly clay loam, olive gray (5Y 4/2) moist; moderate, medium and thick, platy structure; very hard, friable, sticky and plastic; 45 percent cobbles and stones; strong effervescence; many white threads of lime and lime-filled seams between the plates, lime crusts on

cobbles and pebbles; moderately alkaline; gradual, wavy boundary.

C3—41 to 60 inches, light olive-gray (5Y 6/2) cobbly heavy loam, olive gray (5Y 5/2) moist; massive; very hard, friable, sticky and plastic; 45 percent cobbles and stones; strong effervescence; a few threads of segregated lime, crusts of lime on cobbles and stones; moderately alkaline.

The depth to calcareous material ranges from 7 to 18 inches. Content of rock fragments ranges from 25 to 65 percent, by volume, throughout.

WG—Whitore stony loam, hilly (8 to 35 percent slopes). This soil is on uplands. Slopes are mainly 8 to 15 percent. This soil has a profile similar to that described as representative of the series, but the surface layer is stony loam.

Included with this soil in mapping are a few small areas of poorly drained soils in swales. Also included are small areas of Adel and Loberg soils.

Runoff is medium or rapid. The hazards of water erosion and soil blowing are slight or moderate.

This soil is suited to woodland and grazeable woodland. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 7f2; windbreak suitability group 4.

WH—Whitore complex, rolling (2 to 15 percent slopes). This complex is on uplands. This complex is about 70 percent Whitore cobbly loam and 25 percent other soils, mainly Hanson, Loberg, and Raynesford soils. Slopes are mainly 4 to 8 percent. The Whitore soil is on side slopes. Hanson soils are on knolls and ridges and Loberg and Raynesford soils are in swales. The Whitore soil has the profile described as representative of the series.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are poorly drained Bear Lake soils in swales.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to woodland and grazeable woodland. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 7f1; windbreak suitability group 3L.

WL—Whitore complex, hilly (8 to 35 percent slopes). This complex is on uplands. This complex is about 70 percent Whitore cobbly loam and 25 percent other soils, mainly Hanson, Loberg, and Raynesford soils. Slopes are mainly 8 to 15 percent. Whitore soils are on side slopes. Hanson soils are on knolls and ridges and Loberg and Raynesford soils are in swales.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are poorly drained Bear Lake soils in swales.

Runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to woodland and grazeable woodland. Capability unit VIe-1, dryland; not assigned to a range site; woodland suitability group 7f1; windbreak suitability group 4.

Williams Series

The Williams series consists of deep, well-drained soils on uplands. These soils formed in glacial till. Ele-

vation ranges from 4,000 to 4,600 feet. Slopes are 2 to 35 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, western and thickspike wheatgrass, and green needlegrass. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 100 days.

In a representative profile the surface layer is dark-gray cobbly loam 3 inches thick. The subsoil is dark-brown, brown, and grayish-brown clay loam 18 inches thick. The substratum is grayish-brown clay loam.

Permeability is moderately slow. Available water capacity is high. Reaction is neutral to a depth of 15 inches and moderately alkaline below that depth. Organic-matter content is medium in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed small grain and tame pasture.

Representative profile of Williams cobbly loam, undulating, in native grass, 1,500 feet east and 600 feet south of the northwest corner of sec. 14, T. 32 N., R. 11 W.:

A1—0 to 3 inches, dark-gray (10YR 4/1) cobbly loam, very dark brown (10YR 2/2) moist; moderate, fine, crumb structure; soft, very friable, nonsticky and nonplastic; 20 percent cobbles; neutral; clear, wavy boundary.

B21t—3 to 9 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate, medium, prismatic structure that parts to moderate, medium subangular blocks; hard, friable, sticky and plastic; thin, continuous clay films on peds; 15 percent cobbles and pebbles; neutral; clear, wavy boundary.

B22t—9 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak, medium, prismatic structure that parts to weak, medium, subangular blocks; slightly hard, friable, slightly sticky and slightly plastic; thin, discontinuous, dark grayish-brown (10YR 4/2) clay films on vertical ped surfaces; 15 percent pebbles; neutral; clear, wavy boundary.

B3ca—15 to 21 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure that parts to weak, medium and fine angular blocks; slightly hard, friable, slightly sticky and slightly plastic; 10 percent pebbles; strong effervescence; many, very fine threads of lime, lime crusts on the bottom of pebbles; moderately alkaline; clear, wavy boundary.

C1ca—21 to 31 inches, grayish-brown (2.5Y 5/2) heavy clay loam, very dark grayish brown (2.5Y 3/2) moist; weak, medium and fine, subangular blocky structure; hard, friable, sticky and plastic; 15 percent pebbles; strong effervescence; many threads and coatings of segregated lime; moderately alkaline; clear, wavy boundary.

C2ca—31 to 60 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; very hard, firm, sticky and plastic; 15 percent pebbles; strong effervescence; a few threads and coats of segregated lime; moderately alkaline.

The depth of calcareous material ranges from 10 to 20 inches. The A1 horizon is cobbly loam or loam. Content of rock fragments ranges from 10 to 25 percent, by volume, throughout. The C horizon is loam and clay loam.

Wk—Williams cobbly loam, gently sloping (2 to 4 percent slopes). This soil is on glacial uplands that have low relief. It has a profile similar to the one described as representative of the series, but in a few areas the soil is noncalcareous above a depth of 20 inches.

Included with this soil in mapping are a few areas of mainly well-drained soils in swales that have only a few cobbles and pebbles in the surface layer. Also

included are a few small closed basins of poorly drained soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain, tame pasture, and range. Capability unit IIIe-2, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

Wm—Williams cobbly loam, undulating (2 to 8 percent slopes). This soil is on uplands. Relief is 5 to 15 feet. Slopes are mainly 2 to 4 percent. This soil has the profile described as representative of the series. The noncalcareous upper part of the profile, however, ranges from 10 to 20 inches in thickness.

Included with this soil in mapping are small areas of well-drained Arnegard soils in swales and basins, Zahl soils on windswept ridges and knolls, and Nishon soils that are ponded by runoff from adjacent slopes. In some places the soils on ridges and knolls have a very gravelly surface layer.

Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

This soil is suited to dryfarmed small grain, hay, and tame pasture. Capability unit IIIe-2, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

WN—Williams complex, hilly (4 to 35 percent slopes). This complex is on uplands. It is about 50 percent Williams cobbly loam and 30 percent Williams loam. Slopes are mainly 8 to 15 percent. The soils have profiles similar to that described as representative of the series, but in some areas only a few cobbles and pebbles are in the surface layer.

Included with these soils in mapping, and making up 20 percent of the mapped area, are Zahl, Arnegard, and Nishon soils.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

WO—Williams complex, steep (15 to 35 percent slopes). This complex is on hills, ridges, and foot slopes. It is about 70 percent Williams cobbly loam and 20 percent Williams loam. The soils have profiles similar to that described as representative of the series, but the noncalcareous part of the profile is mostly about 10 inches thick. The Williams loam has a few pebbles and cobbles in the surface layer.

Included with these soils in mapping, and making up about 10 percent of the mapped area, are very gravelly and very cobbly soils, seeps, and shale or sandstone outcrop.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Wr—Williams-Zahl complex, undulating (2 to 8 percent slopes). This complex is on uplands. This complex is about 50 percent Williams loam and 45 percent Zahl cobbly loam. Slopes are mainly 2 to 4 percent. The Williams soil is in concave areas, and the Zahl soil is in convex areas. The Williams soil has a profile similar to that described as representative of the Williams series, but the surface layer and substratum are loam. The Zahl soil has a profile similar to that described as representative of the Zahl series, but the texture is cobbly loam.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are very gravelly and cobbly soils on ridges and poorly drained soils in swales and closed basins.

Runoff is slow or medium. The hazards of water erosion and soil blowing are moderate.

The soils in this complex are suited to small grain, tame pasture, and range. Capability unit IIIe-2, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 1.

WS—Williams-Zahl complex, hilly (4 to 35 percent slopes). This complex is on uplands. This complex is about 50 percent Williams loam and cobbly loam and 45 percent Zahl cobbly loam. Slopes are mainly 8 to 15 percent. The Williams soils have a profile similar to that described as representative of the Williams series, but the surface layer is loam or cobbly loam and the substratum is loam. The Zahl soil has a profile similar to that described as representative of the Zahl series, but the texture is mostly cobbly loam.

Included with these soils in mapping, and making up about 5 percent of the mapped area, are very gravelly and cobbly soils on ridges, poorly drained soils in closed basins, and well-drained Arnegard soils in swales.

Runoff is medium or rapid. The hazard of water erosion is moderate, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Silty range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

WT—Williams-Zahl complex, steep (15 to 35 percent slopes). This complex is on uplands. This complex is about 40 percent Williams loam and cobbly loam and 40 percent Zahl cobbly loam. The Williams soils in this complex have profiles similar to that described as representative of the series, but the surface layer is loam and cobbly loam, the noncalcareous material is about 10 inches thick, and the substratum is loam. The Zahl soil has a profile similar to that described as representative of the series, but the texture is mostly a cobbly loam.

Included with these soils in mapping, and making up about 20 percent of the mapped area, are very droughty soils, soils that are over shale and sandstone, moderately deep loam soils, seeps, and shale or sandstone outcrop.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to range. Capability unit VIe-1, dryland; Silty range site, 12- to 14-

inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Yetull Series

The Yetull series consists of deep, well-drained soils on terraces and uplands. These soils formed in granitic alluvium. Elevation ranges from 3,600 to 4,400 feet. Slopes are 2 to 8 percent. The native vegetation is mainly prairie sandreed, needleandthread, and some perennial forbs and woody plants. The mean annual precipitation is 12 to 14 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 100 to 110 days.

In a representative profile the surface layer is dark grayish-brown and grayish-brown fine sand 8 inches thick. The underlying material is brown and pale-brown sand.

Permeability is rapid. Available water capacity is low. Reaction is mildly alkaline. Organic-matter content is low in the surface layer.

These soils are used mainly for range.

Representative profile of Yetull fine sand in native grass, 660 feet north and 100 feet east of the southwest corner of sec. 5, T. 37 N., R. 7 W.:

- A11—0 to 2 inches, dark grayish-brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grained; loose; nonsticky and nonplastic; slight effervescence; mildly alkaline; clear, smooth boundary.
- A12—2 to 7 inches, grayish-brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grained; soft, very friable, nonsticky and nonplastic; slight effervescence; mildly alkaline; abrupt, smooth boundary.
- A13—7 to 8 inches, grayish-brown (10YR 4/2) sand, very dark brown (10YR 2/2) moist; single grained; soft, very friable, nonsticky and nonplastic; slight effervescence; mildly alkaline; abrupt, smooth boundary.
- C1—8 to 19 inches, brown (10YR 5/3) sand, dark grayish brown (10YR 4/2) moist; single grained; soft, very friable, nonsticky and nonplastic; dark-brown (10YR 2/2), moist, bands occur in this horizon; strong effervescence; mildly alkaline; abrupt, smooth boundary.
- C2—19 to 60 inches, pale-brown (10YR 6/3) sand, yellowish brown (10YR 5/4) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; strong effervescence; mildly alkaline.

The content of pebbles ranges from 0 to 10 percent, by volume.

Ye—Yetull fine sand (2 to 8 percent slopes). This gently sloping or moderately sloping soil is on terraces and uplands.

Included with this soil in mapping are a few small blowout areas. Also included are small areas of Tally soils.

Runoff is slow. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is severe.

This soil is suited to range. Capability unit VI_s-1, dryland; Sandy range site, 12- to 14-inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 3M.

Zahl Series

The Zahl series consists of deep, well-drained to excessively drained soils on uplands. These soils formed

in calcareous glacial till. Elevation ranges from 3,400 to 4,600 feet. Slopes are 8 to 35 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, western and thickspike wheatgrass, and green needlegrass. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 39° to 41° F, and the growing season is 90 to 110 days.

In a representative profile the surface layer is dark grayish-brown light clay loam 5 inches thick. The underlying material is grayish-brown clay loam 35 inches thick and light olive-gray gravelly loam.

Permeability is moderately slow. Available water capacity is moderate or high. Reaction is mildly alkaline to a depth of 5 inches and moderately alkaline below that depth. Organic-matter content is low in the surface layer.

These soils are used mainly for range. Some areas are used for dryfarmed small grain and tame pasture.

Representative profile of Zahl clay loam in an area of Zahl complex, hilly, in a cultivated field, 800 feet south and 200 feet east of the center of sec. 10, T. 31 N., R. 5 W.:

- Ap—0 to 5 inches, grayish-brown (2.5Y 4/2) light clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, very fine, crumb structure; slightly hard, very friable, sticky and slightly plastic; 10 percent pebbles; slight effervescence; mildly alkaline; abrupt, smooth boundary.
- C1ca—5 to 9 inches, dark grayish-brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse, prismatic structure; hard, friable, sticky and plastic; 15 percent pebbles; strong effervescence; common lime nodules; moderately alkaline; gradual, wavy boundary.
- C2ca—9 to 28 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse, prismatic structure; hard, friable, sticky and plastic; 10 percent pebbles; strong effervescence; masses and seams of white lime; moderately alkaline; gradual, wavy boundary.
- C3ca—28 to 40 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; 10 percent pebbles; strong effervescence; few nodules of segregated lime; moderately alkaline; abrupt, wavy boundary.
- IIC4cs—40 to 60 inches, light olive-gray (5Y 6/2) gravelly loam, olive gray (5Y 4/2) moist; massive; extremely hard, firm, very sticky and very plastic; 25 percent pebbles; strong effervescence; moderately alkaline.

The A horizon ranges from 3 to 6 inches in thickness. In some places, it is leached of lime in the upper 2 to 4 inches. The A horizon is clay loam or cobbly loam. The content of rock fragments ranges from 10 to 35 percent, by volume, throughout. The C horizon is clay loam or gravelly loam.

ZA—Zahl complex, hilly (8 to 35 percent slopes). This complex is on uplands. It is about 60 percent Zahl clay loam or cobbly loam and 30 percent Kevin loam. Slopes are mainly 8 to 15 percent. Zahl soils are in convex areas, and the Kevin soil is in concave areas and has slopes of 8 to 15 percent.

Included with these soils in mapping, and making up 10 percent of the mapped area, are Arnegard and Scobey soils.

Runoff is rapid or very rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight or moderate.

The soils in this complex are suited to range. Capability unit VI_e-1, dryland; Silty range site, 12- to 14-

inch precipitation zone; not assigned to a woodland suitability group; windbreak suitability group 4.

Use and Management of the Soils

This section describes the general use and management of soils in the survey area for irrigated and dry-farmed crops, for native range, for woodland, for windbreaks, and for wildlife. It also describes soil characteristics important to engineers, and it gives information that is important in planning engineering works. An explanation of the capability classification system used by the Soil Conservation Service is also given.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations 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 land forming 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 requiring 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 soils are grouped at three levels—the capability class, the subclass, and the unit. These levels are described 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 subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or 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 land forms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or to esthetic purposes.

Class I and II soils are not used in this survey area because the short growing season severely limits the choice of crops.

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, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that the 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 or range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. 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, IIIe-4 or IVs-1. 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.

Soils in the survey area in capability classes III and IV are grouped into capability units which specify management needs for growing crops. Soils in capability classes V, VI, VII, and VIII are grouped in a single capability unit as applicable.

Dryfarmed Crops

Approximately 360,000 acres of the survey area is used for the production of dryfarmed crops. Wheat and barley are by far the most important. Other minor crops are oats, rye, flax, mustard, and tame hay and pasture. Both winter wheat and spring wheat are grown.

In this section, the general practices used in maintaining productivity and controlling erosion are discussed. Capability units are described, and specific management practices applying to each unit are given. Estimated yields of the major dryfarmed crops are given in section headed "Predicted Yields."

Dryland management practices

The main concerns in managing dryland in the survey area are conserving moisture, protecting the soil from blowing and water erosion, and controlling weeds.

Most of this area does not receive enough precipitation during the growing season to produce a profitable crop. A small grain-fallow rotation is used to overcome this deficiency. Accumulation of moisture in the soil during the fallow period is small, ranging from 10 to 40 percent of the annual precipitation, yet this has been sufficient to virtually eliminate crop failure. Each additional inch of water that can be stored in the soil during the fallow period, by good weed control and other moisture-conserving practices, helps to produce an estimated additional 4 to 6 bushels of wheat per acre.

Not all the soils are capable of storing the water received during the fallow period, especially the amount received in years of above-normal precipitation. Water is lost by deep percolation, and there is an accompanying loss of plant nutrients. The excessive amount of moisture during the summer-fallow period is the cause of the saline seep problems of some soils.

If fertility is properly managed and soil moisture available at seeding time is known, some soils in the survey area can be successfully cropped with a two-crop-fallow rotation, or with a continuous crop system.

Some areas are seeded to perennial grasses and legumes for hay and pasture and, occasionally, for the production of seed. In most cases where planting has been successful on soils in this area, the soils are only occasionally put back to grain production because of the uncertainty of establishing a good stand. The steeper soils are better suited to hay and pasture than to small grain, because hay and pasture reduce soil loss.

Stubble mulching keeps crop residue on the surface. This practice aids infiltration of water, protects the soil from raindrop splash, and reduces soil blowing. The amount of residue needed for good protection varies with the soil, the topography, and the size of the field. Each cultivation covers part of the residue and breaks up soil clods. Disk-type cultivators cover as much as 50 percent of the residue in one operation, while the common shovel-type cultivator covers only about 20 percent. Proper stubble for the soil can be planned through consideration of the size of the crop, the number of cultivations needed, and the kind of implement used.

Contour stripcropping on sloping soils reduces erosion and stores moisture for plant use. Operating machinery on the contour reduces power requirements and creates small reservoirs that trap water. Pairs of strips commonly are separated by a permanent grass buffer strip. Cropped strips are usually uniform in width. Irregular areas caused by changes in the slope of the soil are more conveniently included in the buffer strip than cropped. The width of the strip varies mainly with the kind and steepness of the soil. Where contours run east and west, parallel to the prevailing wind, consideration should be given to the hazard of soil blowing.

Wind stripcropping is a system of planting alternate strips of crop and fallow as nearly as is practical at right angles to the direction of the most damaging winds in order to reduce soil blowing. The width of strips needed varies, depending on the texture of the soil, cloddiness, and amount of residue. In determining exact strip width, consideration should be given to the size of equipment used.

Field windbreaks are one or more rows of trees or shrubs planted in or around fields to reduce soil blowing, control snow drifting, conserve moisture, and protect crops. These windbreaks also protect livestock, provide food and shelter for wildlife, and enhance the natural beauty of an area. Field windbreaks commonly are oriented at a right angle to the prevailing wind.

Grassed waterways within areas of crops carry away runoff. Waterways are designed and shaped according to the slope of the soil, amount of runoff, and kind of soil. These are critical areas warranting special care in seeding, fertilization, inspection, and repair. Hay should be mowed and removed at least once each year to prevent the channel from filling with silt. Machinery should be lifted when crossing waterways, and grassed waterways should not be used as roadways.

Terraces are earth embankments or ridges constructed across the slope to reduce slope length and intercept runoff. Terraces are commonly used for erosion control in some parts of the county but are not common in this area, mainly because of the high cost of installation and maintenance; but they can be used effectively. Gradient terraces intercept and carry runoff to suitable outlets. Level terraces are designed to allow runoff to be absorbed by the soil rather than removed.

Diversions can be used where runoff from higher lying lands is damaging cropland, pasture, or farmsteads. They are similar to gradient terraces in design and soil requirements.

Waterspreading diverts water from a natural channel and spreads it over a relatively flat area to supplement the normal precipitation. Waterspreading areas are usually used for hay or pasture. Soils must be capable of taking and storing the added moisture and of producing economical yield increases.

Rock removal is common on many of the soils brought into use for crops from native sod. Fragments larger than 6 inches in diameter are a concern in cultivation and harvest operations. The volume of these fragments seldom exceeds 5 to 10 cubic yards per acre on cropped soils. Gravelly and cobbly soils are common in the survey area. Locally, they are not considered a particular difficulty in use of the land; however, at times they are a nuisance. Shovel drills work better on these soils than do disk-type drills. A few farmers have constructed large steel drum rollers to push the pebbles and cobbles into the soil. However, rolling crushes soil clods and leaves the surface subject to soil blowing. Subsurface tillage tends to concentrate fragments on the surface, and some soils appear extremely gravelly and cobbly.

Dryland capability units

In this section each dryland capability unit in the survey area is described and soil characteristics and hazards in management are explained. Also, suitable

crops and management practices are given. The capability unit in which any soil has been placed can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The management of soils in capability classes V to VII is discussed in the sections "Range" and "Woodland" under the appropriate range site or woodland suitability group in which the soils have been placed.

CAPABILITY UNIT IIIe-1, DRYLAND

This unit consists of deep, well-drained and moderately well drained soils that have a surface layer of loam or clay loam. Some of the soils are cobbly. Slopes are mainly less than 2 percent. Mean annual precipitation is 14 to 16 inches, and the growing season is 90 to 100 days.

Most of the soils have moderate to moderately slow permeability, but in a few small areas the soils have very slow permeability. The available water capacity is moderate or high. Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soils are suited to small grain, hay, and tame pasture.

Stubble mulch tillage, wind stripcropping, and field windbreaks control soil blowing. A small grain-fallow rotation may not be necessary or desirable in many years.

CAPABILITY UNIT IIIe-2, DRYLAND

This unit mainly consists of deep and moderately deep, well-drained soils that have a surface layer of loam, silt loam, or clay loam; some are cobbly. Shale is at a shallow depth in a few small areas. Slopes are 2 to 8 percent. Mean annual precipitation is 14 to 16 inches, and the growing season is 90 to 105 days.

The soils mainly have moderate or moderately slow permeability but some soils have very slow permeability in the substratum. The available water capacity ranges from low to high. Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

The soils are suited to small grain, hay, and tame pasture.

Stubble-mulch tillage, wind stripcropping, and field windbreaks help to control soil blowing. Some slopes are suited to contour stripcropping or field stripcropping to help to reduce runoff and water erosion. Grassed waterways are needed in many areas. In many years, a grain-fallow rotation is not needed.

CAPABILITY UNIT IIIe-3, DRYLAND

This unit consists mainly of deep and moderately deep, well-drained and moderately well drained soils that have a surface layer of loam to clay. Some of the soils are gravelly or cobbly. In a few small areas mapped with deep soils, the soils are shallow to shale. Slopes are 0 to 8 percent. Mean annual precipitation is 12 to 14 inches, and the growing season is 95 to 110 days.

The soils mainly have very slow to moderate permeability, but some soils have rapid permeability in the substratum. The available water capacity is low to high. Runoff is slow to moderate. The hazard of water

erosion is slight to moderate, and the hazard of soil blowing is moderate.

The soils are suited to small grain, hay, and tame pasture.

Soil blowing during the fallow period is the main limitation to use of these soils. Wind stripcropping and stubble mulch tillage together generally give adequate protection against soil blowing. One of these practices may suffice in some places. In places field windbreaks can be substituted for narrow strips. Some of the slopes are suitable for contour stripcropping and for field stripcropping. Grassed waterways are needed in many areas.

CAPABILITY UNIT IIIe-4, DRYLAND

This unit consists of deep, well-drained soils that have a surface layer of sandy loam or loam. Some of the soils are cobbly. Slopes are 0 to 8 percent. Mean annual precipitation is 12 to 14 inches, and the growing season is 100 to 110 days.

The soils have moderate or moderately rapid permeability, and most have a very rapidly permeable substratum. The available water capacity is low or moderate. Runoff ranges from slow to medium. The hazard of water erosion is slight to moderate, and the hazard of soil blowing is moderate.

The soils are suited to small grain, hay, and tame pasture.

Stubble mulch tillage, wind stripcropping, and field windbreaks control soil blowing. Some slopes are suitable for contour stripcropping or field stripcropping to reduce runoff and water erosion. Grassed waterways are needed in many areas.

CAPABILITY UNIT IIIw-1, DRYLAND

This unit consists only of Gallatin loam. It is a deep, somewhat poorly drained soil. It has a surface layer of loam and a substratum of stratified loam, sandy loam, and silty clay loam. It has a seasonal water table at a depth of 4 to 5 feet. Slopes are 0 to 2 percent. Mean annual precipitation is 14 to 19 inches, and the growing season is 80 to 100 days.

This soil has slow permeability, and available water capacity is high. Runoff is slow. The hazards of water erosion and soil blowing are slight.

This soil is suited to tame pasture, hay, and small grain.

This soil must be cultivated for several years to break up the native sod and to prepare a good seedbed. This soil is suited to orchardgrass, smooth brome, ladino clover, and red clover. Alfalfa grows well in some areas, but alfalfa may be short lived because of the high water table. Commercial fertilizer is needed for good production. Summer fallow is not needed for moisture accumulation, because the subsoil commonly receives moisture from the water table in spring. Small grain, commonly oats and barley, are grown for hay and sometimes for grain. Winter wheat commonly does not survive well, because of wetness or ponding.

CAPABILITY UNIT IVe-1, DRYLAND

This unit consists of deep and moderately deep, well-drained and moderately well drained soils that have a surface layer of loam, silt loam, or clay loam. Some of the soils are cobbly or gravelly. Slopes are

mainly 4 to 10 percent, but some soils have slopes of 2 to 4 percent. Mean annual precipitation is 15 to 35 inches, and the growing season is 60 to 95 days.

The soils have moderate to slow permeability, and the available water capacity is moderate or high. Runoff is slow or medium. The hazards of soil blowing and water erosion are slight or moderate.

The soils are suited to hay and tame pasture. Some of these soils are also suited to small grain.

Many of these soils are suitable for contour strip-cropping or field strip-cropping. Terraces help to control runoff and water erosion. If runoff is well controlled, soil moisture is often sufficient to grow small grain without summer fallow. A combination of practices of stubble mulch tillage, wind strip-cropping, or field windbreaks are needed if summer fallow is regularly practiced. Grassed waterways commonly are needed.

CAPABILITY UNIT IVe-2, DRYLAND

This unit consists mainly of deep and moderately deep, well-drained and somewhat excessively drained soils that have a surface layer of loam, silt loam, or cobbly loam. In a few small areas mapped with moderately deep soils, the soils are shallow to shale. Slopes are mainly 8 to 15 percent. Mean annual precipitation is 14 to 20 inches, and the growing season is 60 to 100 days.

The soils have moderate permeability. The available water capacity is moderate or high, except in the shallow soils. Runoff is medium or rapid. The hazard of water erosion is moderate or severe, and the hazard of soil blowing is moderate.

The soils are suited to tame pasture and hay. They are less well suited to small grain.

Perennial crops should be grown most of the time for adequate control of runoff and erosion. Small grain can be grown for 1 year to 3 years to prepare seedbed for reestablishing perennial crops or in a regular rotation with perennial crops. Close-growing plants are preferable to bunch-type plants. Some slopes are suitable for contour strip-cropping, field strip-cropping, or terraces. Grassed waterways may be needed in many areas.

CAPABILITY UNIT IVe-3, DRYLAND

This unit consists mainly of deep and moderately deep, well-drained and excessively drained soils that have a surface layer of sandy loam to clay loam. In a few areas mapped with deep and moderately deep soils, the soils are shallow to shale. Some of the soils are cobbly or gravelly. Slopes are mainly 4 to 15 percent. Mean annual precipitation is 12 to 16 inches, and the growing season is 90 to 110 days.

The soils have slow to moderate permeability, and the available water capacity is low to high. Runoff is medium or rapid. The hazards of soil blowing and water erosion are moderate or severe.

The soils are suited to tame pasture and hay. They are less well suited to small grain.

Good stubble mulch tillage is important on these sloping soils if they are used for small grain. A few slopes are suitable for contour strip-cropping or for field strip-cropping. Other areas need windstrips. Grassed waterways are needed in many places. Plants

used for hay and pasture should be close-growing species to control water erosion.

CAPABILITY UNIT IVe-4, DRYLAND

This unit consists of deep, well-drained soils that have a surface layer of loam, sandy loam, or cobbly loam. Slopes are mainly 0 to 2 percent, but are as much as 4 percent. Mean annual precipitation is 15 to 24 inches, and the growing season is 60 to 100 days.

The soils have slow to moderately rapid permeability, and the available water capacity is moderate or high. Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

Gapo clay loam, drained, is in this capability unit because it has similar use and management. It has a seasonal high water table at a depth of 3 to 4 feet, but the table is commonly below a depth of 4 feet during the growing season.

The soils are suited to tame pasture, hay, and small grain.

In most years the moisture in the soils early in spring is sufficient for continuous small grain cropping. Good weed control and fertility management are essential for continuous cropping or intermittent fallow rotations. Grass crops respond well to nitrogen. Many areas of gently sloping soils are suitable for contour strip-cropping or field strip-cropping. Terraces may also be useful in preventing runoff and erosion. Areas that are not strip-cropped should have windstrips or field windbreaks if summer-fallow is regularly practiced. Stubble mulch tillage helps to control soil blowing and runoff. Grassed waterways commonly are needed.

The cobbly soils are better suited to pasture than to hay.

CAPABILITY UNIT IVe-1, DRYLAND

This unit consists of deep, somewhat poorly drained and very poorly drained soils that have a surface layer of clay loam or clay. Slopes are 0 to 2 percent. Mean annual precipitation is 12 to 15 inches, and the growing season is 85 to 110 days.

The soils have slow to very slow permeability, and the available water capacity is high. Runoff is ponded. The hazard of water erosion is slight, and the hazard of soil blowing is slight.

The soils are suited to tame pasture, hay, and small grain.

Areas of these soils that are used for small grain commonly are seeded during years in which the soil dries early enough for a crop to mature. Barley is the best crop for late seeding, but oats may be seeded late for hay. Winter wheat will usually not survive, because of wet soil conditions. Weed control is to maintain optimum crop production. Perennial grasses for hay and pasture are the most suitable crops for these soils.

CAPABILITY UNIT IVe-1, DRYLAND

This unit consists of deep, well-drained soils that have a surface layer of loam or gravelly loam. Slopes are 0 to 4 percent. Mean annual precipitation is 12 to 16 inches, and the growing season is 80 to 110 days.

The soils have moderate permeability, and they have moderately rapid to very rapid permeability in the substratum. The available water capacity is low or

very low. Runoff is slow or medium. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soils are managed mainly as range and tame pasture. They are droughty, and careful livestock management is needed to maintain native grass and tame grass species. Plant vigor can be maintained by using fertilizer and other good range management practices. This helps to provide surface residue that will trap snow and water, which provide extra moisture for plant use.

CAPABILITY UNIT IV_s-2, DRYLAND

This unit consists of shallow, well-drained and excessively drained soils that have a surface layer of loam or clay loam. They are underlain by soft shale at a depth of less than 20 inches. Slopes are 2 to 8 percent. Mean annual precipitation is 12 to 15 inches, and the growing season is 90 to 110 days.

The soils have moderate to slow permeability, and the available water capacity is low or very low. Runoff is slow or medium. The hazard of water erosion is moderate, and the hazard of soil blowing is severe.

The soils are suited to tame pasture and small grain. Windstrips and stubble mulch tillage help to provide residue that will trap snow and water, which provide extra moisture for crop production. These practices also help to control soil blowing and water erosion. Summer fallow is of little value on these soils, because of the limited available water capacity.

CAPABILITY UNIT V_w-1, DRYLAND

This unit consists of moderately deep and deep, poorly drained and very poorly drained soils that have a surface layer of sandy loam to clay. The subsoil and substratum range from clay to very gravelly sand. Some of the soils are gravelly or cobbly. These soils receive supplemental water from flooding, from adjacent streams or slopes, or from underground seepage. In some areas, the water table is at a depth of less than 1 or 2 feet during part of the growing season. Slopes are 0 to 20 percent. Mean annual precipitation is 12 to 20 inches, and the growing season is 70 to 100 days.

The soils have slow to moderate permeability, and the available water capacity is low to high. Runoff is slow. The hazards of water erosion and soil blowing are slight.

These soils are suited to range and grass hay.

CAPABILITY UNIT VI_s-1, DRYLAND

This unit consists of shallow to deep, moderately well drained and excessively drained soils that have a surface layer of sand to clay. Some of the soils are gravelly, cobbly, or stony. In a few small areas, the soils are poorly drained or saline. Slopes are 0 to 50 percent. Mean annual precipitation is 12 to 35 inches, and the growing season is 60 to 110 days.

The soils have slow to rapid permeability, and the available water capacity is very low to high. Runoff is slow. The hazards of water erosion and soil blowing are slight.

These soils are suited to range, woodland, and grazeable woodland.

CAPABILITY UNIT VI_w-1, DRYLAND

This unit consists of deep, poorly drained to well-drained soils that have a surface layer of loamy sand to clay. Some of the soils are gravelly or cobbly. These soils receive supplemental water from flooding, from adjacent streams or slopes, or from the high water table. Some of the soils are saline. Slopes are 0 to 15 percent. Mean annual precipitation is 12 to 20 inches, and the growing season is 90 to 110 days.

The soils have very slow to very rapid permeability, and the available water capacity is very low to high. Runoff is slow. The hazards of water erosion and soil blowing are slight to moderate.

These soils are suited to range.

CAPABILITY UNIT VI_s-1, DRYLAND

This unit consists of shallow to deep, moderately well drained to excessively drained soils that have a surface layer of very gravelly sandy loam to clay. Some of the soils are gravelly, very gravelly, channery, or stony. A few soils are alkaline and saline. Slopes are 0 to 30 percent. Mean annual precipitation is 12 to 24 inches, and the growing season is 60 to 110 days.

The soils have very slow to very rapid permeability, and the available water capacity is very low to high. Runoff is slow to rapid. The hazards of water erosion and soil blowing are slight to severe.

These soils are suited to range.

CAPABILITY UNIT VII_s-1, DRYLAND

This unit consists of shallow to deep, well-drained to excessively drained soils that have a surface layer of loam or clay loam. Some of the soils are gravelly, cobbly, channery, or stony. Slopes are 10 to 60 percent. Mean annual precipitation is 12 to 35 inches, and the growing season is 60 to 110 days.

The soils have slow to rapid permeability, and the available water capacity is very low to moderate. Runoff is rapid. The hazards of water erosion and soil blowing are slight to severe.

These soils are suited to range, woodland, and grazeable woodland.

CAPABILITY UNIT VII_w-1, DRYLAND

This unit consists of deep to shallow, excessively drained soils that have a surface layer of very gravelly and cobbly sand. Also in this unit are deep, saline, dense clay soils in dry lake basins. Slopes are 0 to 2 percent. Mean annual precipitation is 12 to 20 inches, and the growing season is 90 to 110 days.

These soils have rapid permeability, and the available water capacity is very low. Playas have very slow permeability, and the available water capacity is high. Runoff is very slow to very rapid. The hazards of water erosion and soil blowing are slight to severe.

These soils are suited to range.

CAPABILITY UNIT VIII_w-1, DRYLAND

Only Fresh water swamp is in this unit. It consists of alluvial soils that have water on or near the surface during most of the growing season. These nearly level soils are in narrow areas along small perennial streams in the mountains.

Fresh water swamp is suited to recreation and to wildlife habitat.

CAPABILITY UNIT VIII₆-1, DRYLAND

This unit consists of Badland, Riverwash, Rock land, Rock outcrop, and Stony land. Riverwash is mostly nearly level and is on gravel bars along major streams. Stony land is mainly moderately sloping and extremely stony and is in alpine areas. It accumulates large quantities of snow. The other parts of this unit are steep and very steep shale and sandstone outcrops, rock mountainsides, and bouldery talus slopes.

These land types are suited to recreation, wildlife habitat, and watershed.

Irrigated Crops

Approximately 30,000 acres of the survey area is used for irrigated crops and pasture. The two main areas, about equal in size, are the Two Medicine Project in Glacier County and the Badger-Fisher Project in Pondera County. Many other areas could be irrigated. The frost-free season is mainly 100 to 110 days.

Hay, pasture, wheat, and barley are the main irrigated crops. The only row crops are a few potato gardens and corn silage trials.

Alfalfa or alfalfa-grass mixtures are common hay crops. Grass or grass-clover mixtures are used for pasture. Established fields are left in hay or pasture as long as they are reasonably productive and not too weedy. Many stands are 10 to 15 years old. When an area is taken out of hay or pasture, a small grain crop commonly is grown for 2 years before the area is returned to hay or pasture. Winter wheat, spring wheat, feed barley, and malting barley are important crops. Losing a crop year to work up sod is not uncommon. Grazing hay aftermath in fall, especially when only one crop of hay is removed, is common. Pastures are commonly grazed throughout the growing season, but some rotation grazing is practiced.

Continuous small grain, with some years of summer-fallow, is also common on irrigated soils. It is an outgrowth of the former grain-fallow rotation used in dryland farming of the area. Irrigation water is applied if the season is dry. In the present continuous small grain rotation, wheat or barley is grown for 2 to 4 years followed by a season of summer-fallow. Fields with bad weed infestations are most often fallowed. Commercial fertilizers containing nitrogen are necessary for continuous small grain production.

Hay and small grain or pasture and small grain in an 8- to 10-year rotation is a suitable cropping system for many of the irrigated soils of the survey area. Well-managed hay or pasture for about two-thirds of the rotation will maintain good soil tilth, organic-matter content, and permeability.

The main concerns in management of irrigated land are controlling water, maintaining productivity and tilth, and controlling weeds.

In addition to the various methods of applying water to soils, the time to irrigate and the amount of water to apply are important aspects of successful management. Water is held in the soil as thin films around the individual soil grains. After irrigation and after the excess water has drained through the soil, the moisture films are thick; this condition is called "field capacity." As plants remove water from the soil, the films become smaller until a water content is reached

at which the plants wilt and do not recover; this is called the "wilting point." The difference in the amount of moisture between field capacity and wilting point is the "available water capacity" and is expressed in inches of water.

A sandy loam soil will hold about an inch of available water per foot of depth, while a clay soil will hold about 2 inches. If both soils are 5 feet deep, they would have available water capacity of 5 and 10 inches, respectively. If, however, the effective rooting depth of the crop, for instance grass pasture, is 3 feet, then the water available to the plant would be 3 inches for sandy loam and 6 inches for clay.

As a general rule, to keep plants growing actively they should be irrigated when half of the available water has been used. In the case of a deep sandy loam with an available water capacity of 5 inches, this would be when 2.5 inches has been used. The amount of water needed to bring the soil back to field capacity would then be 2.5 inches. In the section "Descriptions of the Soils," the available water capacity is given in qualitative terms for each soil, and in the section "Engineering Uses of the Soils," it is given for each soil horizon.

The basic intake rate is the rate at which irrigation water will enter the flooded soil. The rate for sprinkler irrigation is less than that for flooding, and the rate varies with the surface cover afforded by different crops. The minimum time needed for irrigation is equal to the inches of water needed for replenishing the available water content divided by the basic intake rate. For example, if a sandy loam soil in pasture needs 3 inches of water and the basic intake rate is 3 inches per hour, then the minimum time of application is 1 hour. With a basic intake rate of one-half inch per hour, as with clay soils, the time needed would be 6 hours.

Border irrigation is a method of controlled surface flooding. The field is divided into strips by small parallel earth dikes called border ridges, and each strip is irrigated separately. The field is leveled so that each strip has little or no cross slope, but it may have considerable fall in the direction of irrigation. Soils that have slopes of more than 4 percent generally are not suitable for border irrigation. The width of the border strips varies with the stream of water available, the infiltration rate of the soil, and the steepness of slope. Irrigation efficiencies of 60 to 75 percent are possible with border irrigation. Efficiency is expressed as the net amount of water required to fill the root zone divided by the total amount actually applied by the irrigation method used.

Contour ditch irrigation is a suitable, and common, system on soils that have slopes of as much as 15 percent. The ditches are placed on the general contour with a nonerosive grade. Ditch spacing ranges from 75 to 250 feet, depending on the slope and the texture of the soil. Irrigation efficiencies of 40 to 55 percent are possible.

Corrugations are small furrows running in the direction of the slope and spaced 15 to 24 inches apart. Soils that have slopes of 1 to 8 percent are suitable for corrugation. Irrigation efficiencies of 50 to 60 percent are possible.

Sprinkler irrigation can be used on soils that have slopes of as much as 15 percent and an infiltration rate

of one-fourth inch per hour or more. Irrigation efficiencies of 60 to 70 percent are possible with properly designed systems.

Both surface and subsurface drainage systems are commonly needed on irrigated soils. Some soils provide adequate natural subsurface drainage but require a surface system of water removal to prevent excessive ponding. Over-irrigation will create a temporary buildup of the ground water level on some soils. If the soil has a prolonged high water table, deep-rooted crops will be affected and in time the soil will become saline. Once accumulated in the soil, salts are difficult to remove, especially in clay soils that have slow permeability.

Tillage of irrigated soils in the survey area has been done with the usual dryland implements (disks, sweeps, and chisels). The moldboard plow can be used advantageously to incorporate crop residue and break sod. Fall tillage should leave residue on the surface, or the surface should be left rough to prevent soil blowing during winter.

Fertilization is necessary for high crop yields on irrigated soils. Phosphorus and nitrogen are the main elements needed. The amount to apply should be based on soil tests, the kind of crop, and the planned level of management. Response to fertilizer is highly dependent on other management factors, such as weed control, irrigation, and grazing. Areas where the soil has been removed during land leveling require heavy applications of phosphate fertilizer and organic material for quick recovery.

Irrigated capability units

Irrigated crops in the survey area require careful management. This section describes the irrigated capability units, gives suggestions on the management needed, and gives suited crops. The irrigated capability unit in which any soil has been placed can be found by referring to the "Guide to Mapping Units."

CAPABILITY UNIT III₆-1, IRRIGATED

This unit consists of deep, well drained and moderately well drained soils that have a surface layer of loam to silty clay loam. Some of the soils are gravelly. Slopes are 2 to 8 percent. Precipitation is 12 to 16 inches, and the growing season is 90 to 110 days.

The soils have moderate or moderately slow permeability, and the available water capacity is moderate or high. Runoff is slow or medium. The hazard of water erosion is slight or moderate, and the hazard of soil blowing is moderate.

The soils are suited to all crops commonly grown in the survey area.

The common rotations are adequate, and the crops respond to fertilization. Irrigation water is more easily managed on perennial hay and pasture than on small grain.

CAPABILITY UNIT III₆-2, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of clay. Slopes are 2 to 4 percent. Mean annual precipitation is 12 to 14 inches, and the growing season is 95 to 110 days.

The soils have slow or very slow permeability, and the available water capacity is moderate or high. Runoff

is medium. The hazards of water erosion and soil blowing are moderate.

The soils are suited to small grain, hay, and tame pasture.

Small grain should not be grown continuously, because hay and pasture crops are needed to maintain tilth and water intake rate. Fall plowing is desirable, but the surface should be left rough over winter to prevent the granulated clays from drifting. Green-manure crops or barnyard manure are desirable for these soils. Good water management is needed to prevent waterlogging in the soil, because of the slow or very slow permeability of the underlying material of most of these soils.

CAPABILITY UNIT III₆-1, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of fine sandy loam, loam, or cobbly loam. Very gravelly sand is at a depth of about 30 to 40 inches. Slopes are 0 to 4 percent. Mean annual precipitation is 12 to 14 inches, and the growing season is 100 to 110 days.

The soils have moderate or moderately rapid permeability in the surface layer and subsoil and rapid or very rapid permeability in the substratum. The available water capacity is low. Runoff is slow or medium. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soils are suited to small grain, hay, and tame pasture.

Because of the low available water capacity, these soils require frequent irrigation, so they are better suited to pasture than to alfalfa or small grain. In places, soil blowing is a hazard during times of sowing or preparing a seedbed.

CAPABILITY UNIT III₆-2, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of clay. Slopes are 0 to 2 percent. Mean annual precipitation is 12 to 14 inches, and the growing season is 95 to 110 days.

The soils have slow or very slow permeability, and the available water capacity is moderate or high. Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

The soils are suited to small grain, hay, and tame pasture.

Small grain should not be grown continuously, because hay and pasture crops are necessary to maintain tilth and water intake rate. Fall plowing is desirable, but the surface should be left rough over the winter to prevent drifting of the granulated clay. Green-manure crops or barnyard manure is desirable. Good water management is needed to prevent waterlogging of the slowly permeable or very slowly permeable substratum.

CAPABILITY UNIT IV₆-1, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of loam, gravelly loam, or clay. Slopes are 4 to 15 percent. Mean annual precipitation is 12 to 14 inches, and the growing season is 95 to 110 days.

The soils have moderate to very slow permeability, and the available water capacity is moderate or high. Runoff is medium or rapid. The hazard of water ero-

sion is moderate or severe, and the hazard of soil blowing is moderate.

The soils are suited mainly to tame pasture and hay. They are also suited to small grain. Small grain should be grown for only 1 or 2 years when reestablishing hay and pasture. Alfalfa or bunch type grasses should be grown along with close-growing plants to control erosion. Good crop residue management helps to maintain soil tilth and to control erosion.

Predicted Yields

Table 2 shows for each soil the predicted average yields per acre for the main crops under a high level of management.

The yields shown in table 2 are based on farm records, on interviews with farmers and with members of the staff of the Montana Agricultural Experiment Station, and on direct observations by soil scientists and soil conservationists. Considered in making the estimates are the prevailing climate, the characteristics of the soils, and the influence of different kinds of management on the soils.

It should be understood that these yield figures are not intended to apply directly to specific tracts of land for any particular year, because the soils vary somewhat from place to place, management practices differ from farm to farm, and weather conditions vary from year to year. Nevertheless, these estimates appear to be as accurate a guide as can be obtained without detailed and lengthy investigation. They are useful in showing the relative productivity of the soils.

The following are assumed to be part of a high level management system:

1. Using cropping systems that maintain tilth and organic-matter content.
2. Controlling erosion to the maximum extent feasible, so that the quality of the soil is maintained or improved rather than reduced.
3. Maintaining a high level of fertility by frequent soil tests and use of fertilizer in accordance with recommendations of the State Agricultural Experiment Station.
4. Using crop residue to the fullest extent practicable to protect and improve the soil.
5. Following minimum tillage practices where needed because of the hazards of soil compaction and erosion.
6. Using only the crop varieties that are best adapted to the climate and the soils.
7. Controlling weeds by tillage and spraying.

Range²

Approximately 1,170,000 acres of the survey area is native range. Rangeland is land on which the climax or natural potential vegetation is dominated by grasses, grasslike plants, forbs, and shrubs that are suitable for grazing and that are present in sufficient quantities to justify grazing use. The western part of the survey area is mainly rangeland; there are scattered areas of rangeland throughout the eastern part. Rainfall

² JOE WIRAK, range conservationist, Soil Conservation Service, helped to prepare this section.

ranges from about 12 inches in the eastern part to more than 24 inches on the western mountain slopes. Rangeland is extremely important as watershed and for livestock grazing. As a result of past use, about half of the range in the survey area is producing about 50 percent of its grazing potential.

The soils in approximately 80 percent of the range are deep, well-drained silt loams or loams. They are productive, and they produce the majority of the forage for livestock.

The second most extensive group of soils are well-drained to excessively drained loams that are 10 to 20 inches deep over shale or loose gravel. These soils make up about 10 percent of the range. They are moderately productive if properly managed.

Wet soils and wet saline soils make up about 8 percent of the range. They are in many small areas and are important for grazing because they produce the largest amount of forage per acre of any of the soils in range.

Deep, dense clays make up about 2 percent of the range. These are moderately productive if properly managed.

Range sites and condition classes

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 climax, or potential, 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, changes or completely destroys the climax plant community. If the range site has not deteriorated significantly under such disturbance, secondary plant succession moves toward recovery of the climax plant community.

Four range condition classes are used to indicate the degree of departure from the climax vegetation. 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 of the same kind as that in the climax stand. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is less than 25.

When changes occur in the climax plant community, some plant species will increase and others will decrease. By comparing the composition of the present plant community to that of the climax plant community, it is possible to see how individual species have increased while others decreased. Plants not present in the climax community that show up in the present plant community are invaders for the site.

General management of range

The composition of climax and present plant communities, together with other range site information,

TABLE 2.—Predicted average yields per acre of major irrigated and dryfarmed crops under a high level of management

[Soils that are not suited to crops are not listed in this table. Absence of a yield figure indicates that the crop is not commonly grown on the soil]

Soil	Spring wheat		Winter wheat		Barley		Tame pasture		Alfalfa
	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated
	Bu	Bu	Bu	Bu	Bu	Bu	AUM ¹	AUM ¹	Tons
Adel loam, 0 to 4 percent slopes		28		36		50		2.5	
Adel loam, 4 to 10 percent slopes		28		36		50		2.5	
Arnegard loam, 0 to 2 percent slopes		30		38		50		2.2	
Arnegard loam, 2 to 8 percent slopes		26		34		48		1.8	
Attewan sandy loam, 0 to 4 percent slopes		18		28		38		1.2	
Attewan sandy loam, 4 to 8 percent slopes		16		22		34		1.2	
Attewan loam, 0 to 4 percent slopes		20		30		38		1.2	
Attewan loam, 4 to 8 percent slopes		18		26		34		1.2	
Babb cobbly loam, undulating								2.5	
Babb sandy loam, sandy subsoil variant, undulating								2.0	
Boxwell complex, undulating		18		24		34		1.2	
Brockway silt loam, 0 to 2 percent slopes	30	22	40	30	60	38	6.0	1.2	4.0
Brockway silt loam, 2 to 4 percent slopes	25	22	35	30	55	38	6.0	1.2	4.0
Brockway silt loam, 4 to 8 percent slopes	25	20	35	28	50	34	6.0	1.2	3.5
Burnette loam, undulating								2.5	
Bynum silt loam, undulating		28		36		44		2.2	
Bynum-Fifer complex, rolling		18		22		30		1.4	
Cabba loam, undulating		10		14		20		1.2	
Cabba-Reeder complex, undulating		18		24		36		1.6	
Dimmick clay		26						1.6	
Ethridge clay loam, sand substratum, 0 to 2 percent slopes		26		34		44		1.2	
Ethridge clay loam, sand substratum, 2 to 4 percent slopes		20		30		40		1.2	
Ethridge clay loam, sand substratum, 4 to 8 percent slopes		18		26		38		1.2	
Ethridge silty clay loam, 0 to 2 percent slopes	35	24	45	34	65	40	7.0	1.2	4.5
Ethridge silty clay loam, 2 to 4 percent slopes	30	24	40	34	60	40	7.0	1.2	4.5
Ethridge-Absher clay loams, 0 to 2 percent slopes		18		24		30		1.2	
Fairfield loam, 0 to 2 percent slopes	45	24	55	34	75	42	8.0	1.6	5.0
Fairfield loam, 2 to 4 percent slopes	35	24	45	34	65	42	7.0	1.6	4.5
Fairfield loam, 4 to 8 percent slopes	25	22	35	30	60	40	6.0	1.6	4.0
Fairfield gravelly loam, 0 to 2 percent slopes	45	24	55	34	75	40	8.0	1.6	5.0
Fairfield gravelly loam, 2 to 4 percent slopes	35	24	45	34	65	40	7.0	1.6	4.5
Fairfield gravelly loam, 4 to 8 percent slopes	25	22	35	30	60	38	6.0	1.6	4.0
Fairfield cobbly loam, 0 to 4 percent slopes		20		28		34		1.6	
Fairfield-Cabba complex, sloping		18		26		38		1.4	
Fairfield-Utica gravelly loams, 0 to 2 percent slopes		20		26		38		1.4	
Farnuf loam, 0 to 2 percent slopes		24		34		44		1.8	
Farnuf cobbly loam, 0 to 2 percent slopes		24		32		44		1.8	
Farnuf cobbly loam, 2 to 4 percent slopes		24		32		44		1.8	
Farnuf cobbly loam, 4 to 8 percent slopes		22		28		42		1.8	
Farnuf cobbly loam, 8 to 15 percent slopes		18		24		38		1.6	
Gallatin loam		26		32		42		2.2	
Gapo clay loam, drained								2.5	
Kevin loam, 2 to 4 percent slopes		22		28		38		1.2	
Kevin loam, 4 to 8 percent slopes		18		26		34		1.2	
Kevin clay loam, 2 to 4 percent slopes		20		28		34		1.2	
Kevin clay loam, 4 to 8 percent slopes		18		26		34		1.2	
Kevin clay loam, 8 to 15 percent slopes		14		18		30		1.0	
Kiev loam, 2 to 4 percent slopes	30	24	40	34	60	42	7.0	1.6	4.5
Kiev loam, shale substratum, 2 to 4 percent slopes	30	22	35	28	60	38	7.0	1.6	4.5

TABLE 2.—Predicted average yields per acre of major irrigated and dryfarmed crops under a high level of management—Continued

Soil	Spring wheat		Winter wheat		Barley		Tame pasture		Alfalfa
	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated
	Bu	Bu	Bu	Bu	Bu	Bu	AUM ¹	AUM ¹	Tons
Kiev loam, shale substratum, 4 to 8 percent slopes	25	20	35	26	55	38	6.0	1.6	4.0
Kiev loam, shale substratum, 8 to 15 percent slopes	20	18	25	24	34	34	5.0	1.2	3.0
Kiev gravelly loam, 0 to 2 percent slopes	30	24	40	32	60	40	7.0	1.6	4.5
Kiev gravelly loam, 2 to 4 percent slopes	30	24	35	32	60	40	7.0	1.6	4.5
Kiev gravelly loam, 4 to 8 percent slopes	25	20	30	30	55	38	6.0	1.6	4.0
Kiev gravelly loam, 8 to 15 percent slopes	20	16	25	22	40	34	5.0	1.2	3.0
Kiwanis fine sandy loam	30	16	40	26	50	30	6.0	1.2	3.0
Korchea loam, 0 to 2 percent slopes	45	24	55	34	75	42	8.0	1.6	5.0
Korchea loam, 2 to 4 percent slopes	35	24	45	34	65	42	7.0	1.6	4.5
Leavitt cobbly loam, 0 to 2 percent slopes								2.5	
Leavitt cobbly loam, 2 to 4 percent slopes								2.5	
Leavitt cobbly loam, 4 to 8 percent slopes								2.5	
Leavitt cobbly loam, 8 to 15 percent slopes								1.8	
Leavitt complex, undulating		28		34		46		2.0	
Linnet clay, 0 to 2 percent slopes	35	26	45	36	65	44	7.0	1.2	4.5
Linnet clay, 2 to 4 percent slopes	30	26	40	36	60	44	7.0	1.2	4.5
Linnet clay, 4 to 8 percent slopes	25	24	30	34	55	44	6.0	1.2	4.0
Linnet clay, gravelly substratum, 0 to 2 percent slopes	35	24	45	34	65	44	7.0	1.2	4.5
Linnet clay, gravelly substratum, 2 to 4 percent slopes	30	24	40	34	60	44	7.0	1.2	
Litimber clay loam, 2 to 4 percent slopes		24		30		38		1.8	
Litimber clay loam, 4 to 8 percent slopes		22		28		38		1.8	
Litimber cobbly clay loam, undulating		22		28		38		1.8	
Litimber complex, 2 to 8 percent slopes		20		24		34		1.6	
Martinsdale loam, 0 to 2 percent slopes		24		34		44		1.6	
Martinsdale loam, 2 to 4 percent slopes		24		34		44		1.6	
Martinsdale loam, 4 to 8 percent slopes		22		30		44		1.6	
Martinsdale gravelly loam, 2 to 4 percent slopes		24		34		44		1.6	
Martinsdale clay loam, 0 to 2 percent slopes		24		34		44		1.6	
Martinsdale clay loam, 2 to 4 percent slopes		24		34		44		1.6	
Martinsdale clay loam, 4 to 8 percent slopes		22		30		44		1.6	
Martinsdale clay loam, 8 to 15 percent slopes		18		26		38		1.2	
Martinsdale gravelly clay loam, 0 to 2 percent slopes	45	24	55	34	75	44	8.0	1.6	5.0
Martinsdale gravelly clay loam, 2 to 4 percent slopes	35	24	45	34	65	44	7.0	1.6	4.5
Martinsdale gravelly clay loam, 4 to 8 percent slopes	25	22	35	30	60	42	6.0	1.6	4.0
Michelson loam, 0 to 2 percent slopes		32		42		55		2.5	
Michelson loam, 2 to 4 percent slopes		32		42		55		2.5	
Michelson loam, 4 to 8 percent slopes		28		38		50		2.2	
Michelson loam, 8 to 15 percent slopes		24		30		42		1.8	
Michelson cobbly loam, 0 to 2 percent slopes		30		40		55		2.5	
Michelson cobbly loam, 2 to 4 percent slopes		30		40		55		2.5	
Michelson cobbly loam, 4 to 8 percent slopes		28		36		50		2.2	
Michelson cobbly loam, 8 to 15 percent slopes		24		30		42		1.8	
Mord loam, sloping								2.5	
Nishon clay loam		28				42		1.6	
Novary loam								2.5	
Pendroy clay, 0 to 2 percent slopes	30	26	40	36	60	44	6.0	1.2	4.0
Pendroy clay, 2 to 4 percent slopes	30	26	35	36	55	44	6.0	1.2	4.0
Pendroy clay, 4 to 8 percent slopes	25	22	30	30	50	44	5.0	1.2	3.0
Pendroy clay, shale substratum		16		20		30		1.2	
Redchief cobbly loam, gently sloping								2.5	

GLACIER COUNTY AREA, MONTANA

TABLE 2.—Predicted average yields per acre of major irrigated and dryfarmed crops under a high level of management—Continued

Soil	Spring wheat		Winter wheat		Barley		Tame pasture		Alfalfa
	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated
	Bu	Bu	Bu	Bu	Bu	Bu	AUM ¹	AUM ¹	Tons
Redchief cobbly loam, sloping								2.2	
Reeder silt loam, undulating		22		30		38		1.8	
Reeder-Arnegard complex, undulating		24		34		44		1.8	
Savage clay loam, 0 to 2 percent slopes	35	24	50	34	60	40	7.0	1.6	4.0
Savage clay loam, 2 to 4 percent slopes	35	24	45	34	65	40	7.0	1.6	4.5
Savage clay loam, undulating		22		30		38		1.6	
Savage-Rhoades clay loams, 0 to 4 percent slopes		20		28		36		1.6	
Savage-Wayden clay loams, rolling		16		22		30		1.2	
Scobey clay loam, 2 to 4 percent slopes		24		34		40		1.2	
Scobey clay loam, 4 to 8 percent slopes		22		34		40		1.2	
Scobey-Kevin loams, undulating		24		30		42		1.6	
Scobey-Kevin loams, rolling		20		26		34		1.2	
Scobey-Kevin clay loams, undulating		18		24		38		1.2	
Seeped alluvial land								1.8	
Tally sandy loam, 0 to 2 percent slopes		16		22		30		1.6	
Tally sandy loam, undulating		14		18		30		1.6	
Tally sandy loam, rolling		14		20		30		1.6	
Tanna clay loam, 2 to 4 percent slopes		20		30		38		1.2	
Tanna clay loam, 4 to 8 percent slopes		18		24		34		1.2	
Tanna-Absher clay loams		18		24		30		1.2	
Tanna-Wayden clay loams, rolling		14		18		30		1.2	
Thebo clay, undulating		16		20		30		1.2	
Timberg clay loam, undulating		22		28		38		1.8	
Turner loam, 0 to 4 percent slopes	30	16	40	24	50	34	6.0	1.6	3.0
Turner cobbly loam, 0 to 4 percent slopes	30	16	40	24	50	34	6.0	1.6	3.0
Wayden clay loam, undulating		10		14		20		.8	
Williams cobbly loam, gently sloping		24		34		44		1.8	
Williams cobbly loam, undulating		22		30		44		1.8	
Williams-Zahl complex, undulating		22		30		44		1.8	

¹ AUM stands for animal-unit-month, a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre, multiplied by the number of months the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 2 months of grazing for two cows has a carrying capacity of 4 animal-unit-months.

provides the basis for selecting range management systems.

Management programs generally try to increase desirable plants and to restore range to as near climax condition 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.

A management program on range includes forage management, stock control, and special improvement practices (fig. 3).

Forage management is the most important practice in a range management program. It includes proper grazing use, deferred rotation grazing, and rest rotation grazing. Proper grazing use includes a safe degree of use, proper season of use, and range readiness. No more than 50 percent of each year's growth should be taken by grazing animals during the growing season nor more than 60 percent after dormancy. This will maintain the vigor and yield of the better grasses.

Special improvement practices are needed if other management practices will not achieve the desired results or if recovery is too slow from forage management alone. Special practices include range seeding, range pitting, contour furrowing, shallow chiseling, waterspreading, and managing brush.

Pitting, contour furrowing, and shallow chiseling can speed recovery of a range area in two ways. They increase both the rate and the amount of water taken in by the soil, and they reduce the number of less de-

sirable plants in an area. These practices must be followed by deferred grazing to allow the more desirable plants to improve or reestablish themselves. If enough of the better grasses are not present to accomplish this recovery and range seeding is practical, a range seeding in a well prepared seedbed should be made. Range seeding should be followed by grazing deferment to allow for stand establishment.

Stockwater should be established throughout the entire range so that grazing animals do not have far to go for water. Properly planned water developments help to achieve uniform grazing distribution and proper use.

The range condition on all of the range sites can be maintained or improved by proper grazing coupled with a rest rotation or deferred rotation system.

A primary objective of good range management is to keep the range in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. Important changes in the kind of cover on a range site must be recognized. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and its ability to recover.



Figure 3.—An area of a Burnette soil in Silty range site, 15- to 19-inch precipitation zone. Control of grazing, availability of water for livestock, and the use of rough fescue range indicate good management.

Descriptions of range sites

In the following pages, the 17 range sites that occur in the survey area are briefly described and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential annual yield when the site is in excellent condition, unless otherwise identified, for favorable and unfavorable seasons. These yields are given as the normal high and low rather than the extremes. Yields are the total annual yield in pounds of air-dry herbage per acre, which includes the current year's growth of leaves, stems, twigs, and fruit of all plants on the site. Not all of this herbage is usable by livestock. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey.

CLAYEY RANGE SITE, 15- TO 19-INCH PRECIPITATION ZONE

This range site consists of deep and moderately deep, well-drained and moderately well drained soils on stream terraces and fans and on side slopes, ridges, and knolls on uplands. Slopes range from 0 to 35 percent. The surface layer is mainly clay loam, but in places it is loam about 3 inches thick. Some soils contain pebbles, cobbles, and stones. Permeability is very slow to moderate.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: rough fescue, 20 percent; Columbia and green needlegrasses, 10; western and thickspike wheatgrasses, 10; bluebunch wheatgrass, 10; Idaho fescue, 5; plains reedgrass, 10; prairie junegrass, 10; timber danthonia, 5; perennial forbs, 10; and woody plants, 10.

If this site is in excellent condition, it produces approximately 2,100 pounds of air-dry herbage per acre in years that are favorable and as little as 1,600 pounds in years that are not favorable. About 95 percent of the production is from plants that furnish forage for cattle or sheep.

Under prolonged heavy grazing the tall, high-producing grasses are replaced by short grasses, which, in turn, are replaced by annuals, unpalatable forbs, and woody plants.

The vegetation on this site responds to grazing management. Range seeding is suitable where slopes are less than 15 percent.

CLAYEY RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep and moderately deep, well-drained soils on uplands, glacial plains, alluvial fans, and terraces. Slopes are 0 to 40 percent. The surface layer is clay loam or clay. Some soils contain pebbles or cobbles. Permeability is very slow to moderate.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: green needlegrass, 25 percent; western and thickspike wheatgrass, 25; bluebunch wheatgrass, 20; prairie junegrass, 5; plains reedgrass, 5; Sandberg bluegrass, 5; perennial forbs, 10; and woody plants, 5.

If this site is in excellent condition, it produces approximately 1,300 pounds of air-dry herbage per acre in favorable years and as little as 800 pounds in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle and sheep.

If heavy grazing is continuous, the taller, high-producing plants are replaced by increased amounts of plains reedgrass, prairie junegrass, Sandberg bluegrass, curlycup gumweed, broom snakeweed, fringed sagewort, annuals, and other forbs such as wild onion and eriogonum species.

The soils on this site respond to grazing management. Where slopes are less than 25 percent, the soils are suited to range seeding.

DENSE CLAY RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, well-drained soils in glacial lake basins. Slopes range from 0 to 4 percent. The surface layer is mainly clay loam or clay. Some soils have a very thin surface layer over a very slowly permeable subsoil. Permeability is slow or very slow.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: western wheatgrass and thickspike wheatgrass, 45 percent; green needlegrass, 10; canby bluegrass, 5; plains reedgrass, 5; prairie junegrass, 5; squirreltail, 5; greasewood, 10; perennial forbs, 5; and winterfat and Nuttalls saltbush, 10.

If this site is in excellent condition, it produces about 900 pounds of air-dry herbage per acre in favorable years and as little as 500 pounds in unfavorable years. About 85 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing continues over a prolonged period, wheatgrasses and green needlegrass decrease and are replaced by increased amounts of short grasses, squirreltail, greasewood, foxtail barley, tumblegrass, pricklypear, annuals, and unpalatable forbs.

The soils on this site are suited to grazing management, but they are not well suited to mechanical improvement practices.

GRAVEL RANGE SITE, 15- TO 19-INCH PRECIPITATION ZONE

This range site consists of deep, excessively drained Tinsley soils on stream terraces. Slopes are 0 to 2 percent. The surface layer is gravelly sandy loam, cobbly sandy loam, very gravelly sandy loam, or gravelly loam. The soils are underlain by very gravelly sand or very gravelly loamy sand at a depth of 2 to 8 inches. Permeability is rapid.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: bluebunch wheatgrass, 40 percent; rough fescue, 15; Parry danthonia, 10; Idaho fescue, 10; prairie junegrass, 5; Sandberg bluegrass, 5; shrubby cinquefoil, 5; and perennial forbs, 10.

If this site is in excellent condition, it produces approximately 800 pounds of air-dry herbage per acre in favorable years and as little as 500 pounds in unfavorable years.

If heavy grazing is continuous, bluebunch wheatgrass, Parry danthonia, rough fescue, and palatable forbs decrease and are replaced by short grasses, annuals, unpalatable forbs, and woody plants.

Range seeding is not practical on these soils. Seedbed preparation and seeding are difficult, and the soils are very droughty.

OVERFLOW RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, well-drained to very

poorly drained soils that regularly receive excess moisture from run-in or flooding. They are in swales, in depressions, on stream bottoms, and on low terraces. Slopes are 0 to 2 percent. The surface layer ranges from sandy loam to clay. Permeability is very slow to moderately rapid.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: western and thickspike wheatgrass, 25 percent; basin wildrye, 20; green needlegrass, 20; canby bluegrass, 5; bearded and slender wheatgrass, 10; Parry danthonia, 5; perennial forbs, 5; and woody plants, 10.

If this site is in excellent condition, it produces approximately 2,500 pounds of air-dry herbage per acre in favorable years and as little as 1,500 pounds per acre in unfavorable years. About 90 percent of the total production is from plants that furnish forage for cattle or sheep.

If heavy grazing is prolonged, basin wildrye, green needlegrass, and Parry danthonia are replaced by western wheatgrass and Sandberg bluegrass, which in turn are replaced by silver sagebrush, snowberry, Kentucky bluegrass, annuals, and weedy plants.

Most soils in this site are not suited to mechanical treatment, because of the hazard of water erosion if the plant cover is destroyed. Good grazing management usually results in rapid recovery. Recovery of the plant community is slow where the plant cover is dominantly Kentucky bluegrass.

SALINE LOWLAND RANGE SITE, 12- TO 19-INCH PRECIPITATION ZONE

This range site consists only of Saline land. It consists of deep, saline soils that have restricted drainage. They are on uplands, bottom lands, and hillsides. The surface layer ranges from loam to clay. Salt crusts appear whenever the surface layer is dry. Slopes are 0 to 15 percent.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: saltgrass, 15 percent; alkali sacaton, 15; basin wildrye, 10; western wheatgrass, 10; alkaligrass, 5; alkali cordgrass, 5; bearded wheatgrass, 5; sedges, 5; perennial forbs, 5; and greasewood and other woody plants, 25.

If this site is in excellent condition, it produces approximately 3,500 pounds of air-dry herbage per acre in favorable years and as little as 2,500 pounds in unfavorable years. About 85 percent of the total yield is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, the taller, high-producing grasses are replaced by saltgrass, greasewood, foxtail barley, squirreltail, curlycup gumweed, and other unpalatable weedy plants.

These wet, saline soils are not well suited to mechanical treatment, but they respond well to good grazing management.

SALINE UPLAND RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists only of Playas. Playas consists of deep, saline clay in dry lake basins. Slopes are 0 to 2 percent. Permeability is very slow.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: western wheatgrass, 20 percent;

alkali sacaton, 20; saltgrass, 10; Nuttalls saltbush, 10; Sandberg bluegrass, 5; perennial forbs, 5; squirreltail, 5; and greasewood, 25.

If this site is in excellent condition, it produces approximately 500 pounds of air-dry herbage per acre in favorable years and as little as 200 pounds in unfavorable years. About 75 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, alkali sacaton, western wheatgrass, and Nuttalls saltbush decrease, and greasewood, squirreltail, kochia, and saltgrass increase for a while before the site is reduced to bare ground.

Grazing management is the most practical way to maintain or improve range condition on this site.

SANDY RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, well-drained soils on uplands, fans, terraces, and valley bottoms. Slopes are 0 to 20 percent. The surface layer is fine sandy loam, sandy loam, or fine sand. Permeability is moderate to very rapid.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: prairie sandreed, 25 percent; needleandthread, 25; Indian ricegrass, 10; western and thickspike wheatgrass, 10; threadleaf sedge, 10; perennial forbs, 10; and woody plants, 10.

If this site is in excellent condition, it produces approximately 1,600 pounds of air-dry herbage per acre in favorable years and as little as 900 pounds per acre in unfavorable years. About 90 percent of this production is from plants that furnish forage for cattle and sheep.

If heavy grazing is continuous, prairie sandreed, Indian ricegrass, and needleandthread are replaced by threadleaf sedge, green and fringed sagewort, snowberry, wild licorice, annual grasses, and numerous forbs.

The soils in this site generally respond well to grazing management. They are not well suited to mechanical practices, because of the hazard of soil blowing.

SHALLOW RANGE SITE, 15- TO 19-INCH PRECIPITATION ZONE

This range consists of shallow, well-drained to excessively drained soils on uplands. Slopes are 4 to 60 percent. The surface layer ranges from sandy loam to clay loam. Some of the soils contain shale or sandstone fragments or gravel. Permeability is moderate to slow.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: rough fescue, 30 percent; bluebunch wheatgrass, 20; Idaho fescue, 10; Columbia needlegrass, 5; mountain brome, 5; Parry danthonia, 5; short grasses and sedges, 10; perennial forbs, 10; and woody plants, 5.

If this site is in excellent condition, it produces approximately 1,400 pounds of air-dry herbage per acre in favorable years and as little as 800 pounds in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is prolonged, the taller, high-producing grasses are replaced by shorter grasses, annuals, unpalatable forbs, prostrate juniper, and shrubby cinquefoil.

Range seeding is generally not practical, because of Rock outcrop and the steepness.

SHALLOW RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of shallow, well-drained to excessively drained soils on uplands. Slopes are 2 to 60 percent. The surface layer is loam or clay loam. Some of the soils are gravelly, channery, or stony. Permeability is moderately rapid to slow.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: bluebunch wheatgrass, 35 percent; western and thickspike wheatgrass, 15; needleandthread, 15; prairie junegrass, 10; threadleaf sedge, 10; Sandberg bluegrass, 5; perennial forbs, 5; and woody plants, 5.

If this site is in excellent condition, it produces approximately 900 pounds of air-dry herbage per acre in favorable years and as little as 500 pounds in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, bluebunch wheatgrass is replaced by needleandthread, short grasses, and, eventually, annuals, rabbitbrush, fringed sage-wort, broom snakeweed, and other weedy plants.

Range seeding generally is not practical, because of Rock outcrop, stoniness, and steepness.

SHALLOW TO GRAVEL RANGE SITE, 15- TO 19-INCH PRECIPITATION ZONE

This range site consists only of Bearmouth gravelly loam, 0 to 4 percent slopes. It is a deep, well-drained soil underlain by very gravelly sand at a depth of 10 to 20 inches. It is on stream terraces and outwash fans. Permeability is rapid to a depth of 13 inches and very rapid below that depth.

The approximate composition, by percentage of total weight, of the climax (potential) plant community is as follows: rough fescue, 30 percent; bluebunch wheatgrass, 20; Parry danthonia 10; sun sedge, 10; green needlegrass, 5; Idaho fescue, 5; prairie junegrass, 5; timber danthonia, 5; perennial forbs, 5; and shrubby cinquefoil, 5.

If this site is in excellent condition, it produces approximately 1,500 pounds of air-dry herbage per acre in favorable years and as little as 900 pounds in unfavorable years. About 90 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, the taller, high-producing plants are replaced by shorter grasses and sedges, annuals, and unpalatable forbs and woody plants.

Range seeding is practical on the soil in this site.

SHALLOW TO GRAVEL RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, well-drained to excessively drained soils underlain by very gravelly sand at a depth of 10 to 20 inches. They are on fans and terraces. Slopes are 0 to 4 percent. The surface layer is gravelly loam or very gravelly sandy loam. Permeability is moderate to rapid.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: bluebunch wheatgrass, 35 percent; western and thickspike wheatgrass, 15; needleandthread, 10; threadleaf sedge, 10; prairie junegrass, 5; Sandberg bluegrass, 5; blue grama, 5; fringed sage-wort, 5; and forb increasers, 10.

If this site is in excellent condition, it produces approximately 1,000 pounds of air-dry herbage per acre in favorable years and as little as 600 pounds in unfavorable years. About 90 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, bluebunch wheatgrass is replaced by shorter grasses, unpalatable forbs, and woody plants.

The soils in this site respond well to grazing management. Range seeding is practical on most soils in this site.

SILTY RANGE SITE, 20- TO 24-INCH PRECIPITATION ZONE

This range site consists of deep, somewhat excessively drained to moderately well drained soils on fans, terraces, uplands, hills, mountain ridges, and side slopes. The surface layer is loam. Some of the soils are gravelly, cobbly, or stony. Slopes are 4 to 35 percent. Permeability is slow to moderate.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: rough fescue, 20 percent; Richardson needlegrass, 10; Parry danthonia, 10; mountain brome, 10; Columbia needlegrass, 10; blue wildrye, 5; slender and bearded wheatgrass, 5; Idaho fescue, 5; perennial forbs, 15; and woody plants, 10.

If this site is in excellent condition, it produces approximately 2,800 pounds of air-dry herbage per acre in favorable years and as little as 2,000 pounds per acre in unfavorable years. About 90 percent of the production is from plants that furnish forage for cattle or sheep.

If heavy grazing is prolonged, the taller, high-producing grasses are replaced by timber and one-spike danthonia, timothy, Idaho fescue, prairie junegrass, unpalatable weedy forbs, shrubby cinquefoil, and other woody plants.

The soils in this site respond very well to grazing management. Range seeding is practical except on stony soils or soils that have slopes of more than 15 percent.

SILTY RANGE SITE, 15- TO 19-INCH PRECIPITATION ZONE

This range site consists of deep and moderately deep, excessively drained to moderately well drained soils on uplands, fans, terraces, hills, foot slopes, and bottoms. The surface layer ranges from sandy loam to silt loam. Some of the soils are gravelly, cobbly, or stony. Slopes are 0 to 60 percent. Permeability is rapid to slow.

The approximate species composition, by percentage of the total weight, of the climax (potential) plant community is as follows: rough fescue, 30 percent; bluebunch wheatgrass, 20; Idaho fescue, 20; Columbia and green needlegrass, 10; timber danthonia, 5; perennial forbs, 10; and woody plants, 5.

If this site is in excellent condition, it produces approximately 2,200 pounds of air-dry herbage per acre in favorable years and as little as 1,500 pounds per acre in unfavorable years. About 95 percent of the production is from plants that furnish forage for cattle or sheep.

If heavy grazing is prolonged, rough fescue and

bluebunch wheatgrass are replaced by Idaho fescue, timber dantonionia, and balsamroot, which are replaced in turn by short grasses, rabbitbrush, sageworts and sagebrushes, annuals, and other weedy plants.

The soils in this site respond well to grazing management. Mechanical treatment is practical except on stony soils and soils that have slopes of more than 15 percent.

SILTY RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep and moderately deep, excessively drained to moderately well drained soils on uplands, fans, terraces, valley bottoms, and foot slopes. The surface layer is loam, silt loam, silty clay loam, or clay loam. Some of the soils are gravelly and cobbly. Slopes are 0 to 50 percent. Permeability is rapid to slow.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: bluebunch wheatgrass, 30 percent; needleandthread, 20; western and thickspike wheatgrass, 15; green needlegrass, 10; short grasses, 10; threadleaf sedge, 5; perennial forbs, 5; and woody plants, 5.

If this site is in excellent condition, it produces approximately 1,500 pounds of air-dry herbage per acre in favorable years and as little as 1,000 pounds per acre in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, bluebunch wheatgrass and green needlegrass are replaced by needleandthread, blue grama, Sandberg bluegrass, prairie junegrass, and eventually, fringed sagewort, broom snakeweed, annuals, and other weedy plants.

The soils in this range site generally respond well to management. Where there is a heavy mat of clubmoss, range improvement is very slow without mechanical renovation. Range seeding is practical except on soils that have slopes of more than 25 percent.

SUBIRRIGATED RANGE SITE, 12- TO 19-INCH PRECIPITATION ZONE

This range site consists of deep, poorly drained and somewhat poorly drained soils on uplands, low stream terraces, and valley bottoms. The surface layer ranges from sandy loam to clay. Slopes are 0 to 20 percent. Permeability is moderate to slow.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: basin wildrye, 15 percent; prairie cordgrass, 15; slender and bearded wheatgrass, 10; northern reedgrass, 10; tall sedges, 10; tufted hairgrass, 5; low sedges, 10; perennial forbs, 10; and woody plants, 15.

If this site is in excellent condition, it produces approximately 5,000 pounds of air-dry herbage per acre in favorable years and as little as 3,000 pounds per acre in unfavorable years. Approximately 90 percent of this production is from plants which furnish forage for cattle or sheep.

If heavy grazing is continuous, basin wildrye, prairie cordgrass, and other taller, high-producing grasses are replaced by Kentucky bluegrass, redtop, and low sedges which, in turn, are replaced by iris, curlycup gumweed, cocklebur, and other weedy plants.

Wetness restricts mechanical treatment on the soils in this site. However, seeding is practical in areas that have been drained or are dry during part of the year.

WET LAND RANGE SITE, 12- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, very poorly drained soils in major stream valleys. The surface layer is loam or sandy loam. Some areas of soils are fibrous peat 3 to 5 feet deep. Slopes are 0 to 2 percent. The water table is at or near the surface during part of the growing season.

The approximate species composition, by percentage of total weight, of the climax (potential) plant community is as follows: tufted hairgrass, 10 percent; northern reedgrass, 10; prairie cordgrass, 15; reed canarygrass, 15; tall sedges, 20; mannagrass, 5; low sedges, 5; perennial forbs, 5; and willows and other woody plants, 15.

If this site is in excellent condition, it produces approximately 6,000 pounds of air-dry herbage per acre in favorable years and as little as 4,000 pounds per acre in unfavorable years. Approximately 90 percent of this production is from plants that furnish forage for cattle or sheep.

If heavy grazing is continuous, prairie cordgrass, northern reedgrass, mannagrass, and the tall sedges are replaced by low sedges and tufted hairgrass which, in turn, are replaced by Baltic rush, foxtail barley, iris, and other unpalatable forbs and woody plants.

The soils in this site respond well to good grazing management. Mechanical treatment is not practical, because of the high water table.

Woodland³

About 112,000 acres within the survey area are considered commercial woodlands. The major part lies adjacent to Glacier National Park, north of U.S. Highway 2, but there are scattered areas extending south along the mountain front to Swift Reservoir, the southern boundary of the Blackfoot Indian Reservation. Most of the woodlands are Tribal Reserve lands but some areas are in individual ownership. At present woodland management is the responsibility of the forestry department of the Bureau of Indian Affairs at Browning, Montana. Also at Browning is the only mill that uses timber from the survey area.

The largest areas of woodland in the survey area, about 58,000 acres, grows quaking aspen. Conifers grow on the remaining 54,000 acres. Lodgepole pine and Engelmann spruce are the most extensive species and are the major lumber-producing species. Douglas-fir is a minor species at present, but it has been cut for lumber in the past. Alpine fir is the primary regeneration species in selectively logged areas, but it has little present use. Limber and whitebark pine are also common.

Woodlands of the survey area are classified into three major forest cover types by the Society of American Foresters (9).

In the higher elevation zones is the Engelmann spruce-alpine fir type (type 206). In this type spruce

³ By HAROLD E. HUNTER, forester, Soil Conservation Service.

or alpine fir is pure or dominant or a mixture of the two is dominant. Minor associates are Douglas-fir, lodgepole pine, and limber pine. At the middle elevation zone, there are two significant types: lodgepole pine (type 218) and quaking aspen (type 217). In the lodgepole pine type, the lodgepole pine is pure or dominant; however, minor areas of spruce, alpine fir, aspen, limber pine, and Douglas-fir are present. In the quaking aspen type, the quaking aspen is pure or dominant, but it is associated with the ecologically similar species birch and alder and with lodgepole pine. In places, shade-tolerant conifers such as spruce and alpine fir are in the understory.

The following estimates of the existing timber stands and growth rates give a general picture of the woodland resource for the survey area as a whole.

Using average production figures expressed in terms of lodgepole pine, the estimated existing volume of merchantable timber is 282,800,000 cubic feet. The total estimated volume is 310,000,000 cubic feet, or 620,000,000 board feet. The average annual growth, considering a 120-year rotation and average stand density, is 4,220,000 board feet total for the survey area, or about 78 board feet per acre.

Using average production for aspen in the survey area, the estimated existing volume of merchantable timber is 41,250,000 cubic feet. The estimated total volume is 77,950,000 cubic feet, or 459,000 cords. The average annual growth, considering a 70-year rotation and average stand density, is 14,650 cords total for the survey area, or about one-fourth cord per acre.

Little use has been made of the aspen woodlands except as a source of firewood and for grazing. For management details of aspen refer to "Aspen in the Western States" by Krauter (7).

Woodland suitability groups

The soils of the area have been placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group consists of soils that are suited to the same kinds of trees, that need about the same management where the vegetation on them is similar, and that have the same potential production.

Each woodland suitability group is identified by a three-part symbol, such as 4o1, 6x1, or 7f1. The potential productivity of the soils in the group is indi-

cated by the first number in the symbol. Seven productivity groups are recognized regionally, but only groups 4, 5, 6, and 7 are in the survey area. These ratings are based on field determination of average site index. Site index of a given soil is the height, in feet, that the taller trees of a given species reach in a natural, essentially unmanaged stand in a stated number of years. Table 3 gives the site index values used for assigning suitability classes for the species in the survey area. Site index can be converted into approximate expected growth and yield per acre in cubic feet, cords, and board feet. These yields are given in table 4 by woodland suitability group.

The second part of the symbol identifying a woodland suitability group is a small letter. In this survey *x*, *c*, *f*, *r*, and *o* are used. Except for the *o*, the small letter indicates an important soil property that imposes a hazard or limitation in managing the soils of the group for trees. The letter *o* shows that the soils have few limitations that restrict their use for trees; *x* means the soils have large stones in the surface layer which mainly limits equipment use in woodland management; *c* means the soils have limitations for woodland use because of the amount of clay in the soil profile, and because of equipment limitations and a water erosion hazard; *f* means the soils have a large amount of coarse fragments in the profile which limits the available water capacity; and *r* shows that the main limitation is steep slopes and that there is hazard of erosion and possibly limitations to use of equipment.

The last part of the symbol, another number, differentiates woodland suitability groups that have identical first and second parts in their identifying symbol. Soils in group 5o1, for example, require somewhat different management than soils in group 5o2.

The estimated site index in table 4 is the height, in feet, that the taller trees reach at a given age. This is 50 years for spruce, 80 years for aspen, and 100 years for lodgepole pine. The first species listed in the site index column is the one which determines the woodland suitability group.

Average annual yields, given in table 4, are based on the following criteria. For lodgepole pine and spruce, total volume in cubic feet is all trees 6 inches in diameter, or larger, outside bark at breast height. Merchantable volume in cubic feet is based on trees 6 inches or more in diameter between a 1-foot stump and

TABLE 3.—Grouping of site index values into woodland suitability classes by species

[The symbol > means more than; < means less than]

Indicator species	Site index range within woodland suitability classes						
	1 (Very high)	2 (High)	3 (Moderately high)	4 (Moderate)	5 (Moderately low)	6 (Low)	7 (Very low)
Lodgepole pine ¹ -----	>96	95-86	85-76	75-66	65-56	55-46	<45
Engelmann spruce ² -----	>86	85-76	75-66	65-56	55-46	45-36	<35
Quaking aspen ³ -----	>78	77-68	67-56	55-45	<44	-----	-----

¹ Based on height in 100 years (1).

² Based on height in 50 years (5).

³ Based on height in 80 years (4).

a 4-inch top inside bark. Merchantable volume in board feet includes 10-inch diameter breast high outside bark to an 8-inch diameter top outside bark. Yields were based on U.S. Forest Service Region 1 tables with adjustments to fit the stands of the survey area. White pine tables were used for Engelmann spruce. A rotation of 120 years was used for yield calculations of lodgepole pine and Engelmann spruce.

Total volume in cubic feet for aspen considers the entire stem, inside bark. Merchantable volume in cubic feet is trees 6 inches inside and larger. Merchantable volume in cords is calculated as 90 merchantable cubic feet per cord. A rotation of 70 years was used for yield calculations of aspen (6).

In table 4 each woodland suitability group in the area is rated for various management hazards or limitations. These ratings are *slight*, *moderate*, or *severe*, and they are described in the following paragraphs.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions when plant competition is assumed not to be a factor. *Slight* rating indicates a loss of 0 to 25 percent of the seedlings; *moderate* indicates a loss of 25 to 50 percent; and *severe* indicates a loss of more than 50 percent. It is assumed that seed supplies are adequate, planting stock is 2 years old, and stands are evaluated 1 year after planting. Natural regeneration is also evaluated the second year.

Water erosion hazard is evaluated on the basis of soil texture, permeability, potential compaction, and slope characteristics. *Slight* indicates the problems of erosion control are minor. *Moderate* indicates some attention must be given to prevent unnecessary soil erosion. *Severe* indicates that intensive treatments, specialized equipment, and methods of operation must be planned to minimize soil erosion. These evaluations are made on the basis of clearcut areas where slash has been burned. It is further assumed that reasonable care is used in logging so that funneling of skid trails does not occur to concentrate water, excessive disturbance has not occurred, and the coarser residue from slash disposal remains.

Windthrow hazard depends on the soil characteristics that enable trees to resist being blown down by wind. *Slight* indicates that most trees withstand the wind; *moderate* indicates that some trees are expected to blow down during excessive wetness and high wind; *severe* indicates that many trees are expected to blow down during periods when the soil is wet and winds are moderate or high.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. *Slight* indicates that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development; *moderate* indicates that competition delays natural or artificial establishment and growth rate but does not prevent the development of fully stocked normal stands; *severe* indicates that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and maintenance practices such as burning, spraying, disk-ing, or girdling are used.

Equipment limitations depend on soil characteristics that restrict or prohibit the use of harvesting equipment, either seasonally or continually. Soils are evaluated from the standpoint of logging operations. Of prime consideration are the difficulties encountered in yarding logs and the influence of logging activities on soil properties. *Slight* indicates there are no restrictions in the kind of equipment or time of year it is used. *Moderate* indicates that equipment use is moderately restricted in kind or operations by one or more factors such as slope, stones, or obstructions; seasonal soil wetness; physical soil characteristics; injury to tree roots; and soil structure and stability. *Severe* indicates special equipment is needed and its use is severely restricted by one or more of the items listed for *moderate* and by safety in operations.

Woodland grazing

Most of the 112,000 acres of woodland in the survey area is grazed. Some areas are used for summer grazing of sheep and cattle, and some are grazed only by big game animals. The average annual grazing capacity for the survey area is approximately 22,000 animal-unit-months. Because of the heavy snowpack that persists into early summer and the wet soil and adverse weather in fall, grazing of livestock is limited mainly to July and August.

Tree crown cover, tree species, precipitation patterns, kind of soil, and past grazing use or disturbance all greatly affect the understory vegetation. Individual soils, therefore, are not rated for woodland grazing, because the kind of soil is only one of the several variables. More usable forage is produced in woodland areas where the crown cover is less dense. More forage is produced in the aspen woodlands than in areas where conifers are the main species. Livestock grazing is seldom considered in areas where the crown cover is more than 70 percent.

Soils of the Loberg, Tenex, Sherburne, and Swifton series are mainly associated with conifer woodlands that have an understory of forbs and shrubs. Mikesell, Nettleton, and Whitore soils are mainly covered with mixed species, but local areas are dominated by conifers or aspen. The Adel and Babb soils that are dominated by woodland mainly have an aspen cover and an understory of mixed grasses and forbs and shrubs.

Guides for determining forage conditions and optimum stocking rates for grazeable woodlands are available in local Soil Conservation Service offices.

Windbreaks

In this section information is provided on use of soils for windbreaks in the survey area. Each of the windbreak suitability groups is described, and examples of common adapted tree and shrub species are listed for each of the groups.

Windbreaks are belts of trees and shrubs planted to alter the environment for beneficial purposes. Windbreaks are planted to shelter farmsteads and feedlots from the wind and to control drifting snow. Some benefits are reduced fuel and building maintenance costs, reduced stock mortality, and reduced feed requirements. Windbreaks create a more favorable environment in which to live and work around feedlots

TABLE 4.—*Interpretations*

Woodland suitability groups and soil descriptions	Potential productivity per year					
	Species	Site index	Average annual growth per acre			
			Total	Merchantable	Merchantable	Merchantable
			<i>Cubic feet</i>	<i>Cubic feet</i>	<i>Cords</i>	<i>Board feet</i>
4o1: Deep, hilly, black to dark-gray, loamy soils.	Quaking aspen.	49-54	31	25	0.28	
4c1: Deep, hilly soils that have a black and very dark brown loamy surface layer and a slowly permeable, clayey subsoil.	Quaking aspen.	48	29	23	0.26	
5o1: Deep, sloping and hilly, loamy soils that have a gray surface layer.	Lodgepole pine.	58-63	51	47		100
	Engelmann spruce.	38-43		36		
	Quaking aspen.	50-56		36		
5o2: Deep, hilly, black, loamy soils that have a moderately alkaline subsoil.	Quaking aspen.	40	23	16	0.18	
5r1: Deep, steep, loamy soils that have a gray surface layer.	Lodgepole pine.	58-62	48	44		96
	Engelmann spruce.	33-38		31		
5c1: Deep, hilly soils that have a gray surface layer and a moderately slowly permeable, clayey subsoil.	Lodgepole pine.	62	48	47		100
	Engelmann spruce.	37		33		
	Quaking aspen.	50		32		
6o1: Deep, hilly, brown, loamy, very strongly acid to medium acid soils.	Engelmann spruce.	40	39	37		158
	Lodgepole pine.	48		29		
6x1: Deep, hilly to very steep, loamy soils that have a gray, stony surface layer and a gravelly, cobbly, and stony subsoil.	Lodgepole pine.	46	29	26		44
	Quaking aspen.	42				
7f1: Deep, very gravelly and cobbly, loamy soils on rolling and hilly uplands.	Lodgepole pine.	42	23	21		35
	Quaking aspen.	35				
7f2: Deep, hilly to very steep, very gravelly and cobbly, loamy soils that have a stony surface layer; on uplands.	Lodgepole pine.	42	23	21		35
	Quaking aspen.	35				

for woodland management

Hazards and limitations in management					Species priority	
Seedling mortality	Water erosion hazard	Windthrow hazard	Plant competition	Equipment limitations	In existing stands	Use for planting
Slight -----	Slight -----	Slight -----	Slight -----	Moderate -----	Aspen -----	Planting not a practice.
Slight -----	Moderate -----	Slight -----	Slight -----	Severe: com- paction and wetness.	Aspen -----	Planting not a practice.
Slight -----	Slight -----	Slight -----	Slight or moderate: brush.	Moderate -----	Lodgepole pine, spruce, aspen.	Lodgepole pine, spruce.
Slight -----	Slight -----	Slight -----	Moderate -----	Moderate -----	Aspen -----	Planting not a practice.
Moderate -----	Moderate -----	Slight -----	Slight -----	Severe: steep	Lodgepole pine, spruce.	Lodgepole pine, spruce.
Slight -----	Moderate -----	Slight -----	Moderate: brush.	Severe: com- paction and wetness.	Lodgepole pine, spruce, aspen.	Lodgepole pine, spruce.
Slight -----	Slight -----	Slight -----	Moderate: forbs and shrubs.	Moderate -----	Spruce, lodge- pole pine.	Spruce, lodge- pole pine.
Moderate -----	Slight or moderate.	Slight -----	Moderate: grasses and forbs.	Severe: cannot use tree planter.	Lodgepole pine, aspen.	Lodgepole pine.
Severe: droughty soil.	Slight -----	Slight -----	Severe: grasses and forbs.	Moderate -----	Lodgepole pine, aspen.	Lodgepole pine.
Moderate -----	Slight or moderate.	Slight -----	Moderate -----	Moderate -----	Lodgepole pine, aspen.	Lodgepole pine.

and farmsteads. A field windbreak (shelterbelt) is usually a single row planted chiefly to protect fallow fields from soil blowing. By effectively reducing wind-speed, it protects new seedlings and crops and helps to create a beneficial microclimate for plant growth. Winter snows are held on the fields and, thus, soil moisture is increased.

Windbreaks offer more than control of the wind and snow around farmsteads, feedlots, and fields. A good windbreak makes an area more attractive and can furnish food and cover for birds and other wildlife. They can serve as a living snow fence along roads and highways and farms and fields; deaden sounds from highway traffic, industry, or railroads; or screen unsightly areas.

Successful windbreaks need to be planned. Location, selection, and arrangement of species within the windbreak and provisions for weed control are all very important.

The soil should be considered when selecting trees and shrubs for windbreaks. Not all windbreak species grow on all soils. For example, cottonwood and willows do not grow on droughty sandy, very gravelly, or shallow soils. Caragana does not survive on soils that are saturated with water for more than 2 weeks. Assistance in planning farmstead and field windbreaks and information on suitable species are available from the local Soil Conservation Service office or the County Agent.

Descriptions of windbreak suitability groups

Soils in the survey area are grouped into eight windbreak suitability groups based on soil-related hazards and limitations to survival and growth of trees and shrubs commonly used in farmstead and field windbreaks. The capital letters *M*, *L*, *W*, and *S* indicate the four principal factors that are considered in the grouping: *M* indicates the available water capacity of the soil to a depth of 60 inches or to a root-limiting layer; *L*, depth to a concentrated lime zone; *W*, depth to a water table or wetness; and *S*, soil salinity and alkalinity. An Arabic numeral is used to identify the degree of hazard or limitations. The number 1 indicates slight or none; 2, moderate; 3, severe; and 4, very severe. Soils with very severe limitations are not generally suited to windbreaks. The limiting factors for group 4 soils are not indicated in the symbol. Many of the soils are limited by two or more factors.

The Guide to Mapping Units at the end of this publication gives the windbreak suitability group for each mapping unit.

WINDBREAK SUITABILITY GROUP 1

This group consists of soils that have only slight hazards or limitations for windbreaks. Slopes are mainly less than 15 percent. These soils have high or moderate available water capacity. They are noncalcareous or have no lime zone above a depth of 24 inches. They have no permanent water table above a depth of 60 inches, but in some places they have a temporary water table above a depth of 40 inches for a short period in spring. There are little or no harmful soluble salts in these soils.

The soils in this group are suited to all species of trees and shrubs commonly used in the survey area

for windbreaks, such as caragana, lilac, chokecherry, Russian-olive, Siberian elm, green ash, ponderosa pine, Colorado blue spruce, and Rocky Mountain juniper.

WINDBREAK SUITABILITY GROUP 2M

This group consists of soils that dominantly have a moderate available water capacity. The available water capacity is limited by moderate soil depth, sandy texture, and rock fragments. Slopes are less than 15 percent. These soils do not have a concentrated lime zone. Some of the soils are calcareous in the subsoil, and others are noncalcareous throughout.

Salinity, the water table, and wetness are not limitations of these soils. The main consideration in planning farmstead and field windbreaks on these soils is moisture storage capacity.

The soils in this group are suited to caragana, lilac, chokecherry, Russian-olive, Siberian elm, green ash, ponderosa pine, Colorado blue spruce, and Rocky Mountain juniper.

WINDBREAK SUITABILITY GROUP 2L

This group consists of soils that have a concentrated lime zone at a depth of 15 to 24 inches. Most of the soils are noncalcareous in the surface layer, but some are weakly calcareous there. Slopes are less than 15 percent. The available water capacity is high.

Salinity, the water table, and wetness are not limitations of these soils. The main consideration in planning farmstead and field windbreaks on these soils is resistance of the species to high concentrations of lime.

The soils in this group are suited to caragana, lilac, chokecherry, Russian-olive, Siberian elm, green ash, ponderosa pine, and Rocky Mountain juniper.

WINDBREAK SUITABILITY GROUP 2W

This group consists only of Gapo clay loam, drained. This soil has a fluctuating water table that is below a depth of 4 feet during most of the growing season but that in most years is above a depth of 2 feet for a short period. Slopes are mainly less than 2 percent. The available water capacity is high.

Salinity and concentration of lime are not limitations of these soils. The main consideration in planning farmstead and field windbreaks on these soils is resistance of the species to wet soil conditions.

The soil in this group is suited to honeysuckle, lilac, chokecherry, purple willow, Russian-olive, Siberian elm, golden willow, cottonwood, green ash, ponderosa pine, Colorado blue spruce, and Rocky Mountain juniper.

WINDBREAK SUITABILITY GROUP 3L

This group consists of soils that have a concentrated lime zone at a depth of 6 to 15 inches. The surface layer is noncalcareous or moderately calcareous. Slopes are less than 15 percent. The available water capacity ranges from about 5 to 10 inches.

Salinity, the water table, and wetness are not limitations of these soils. The main consideration in planning farmstead and field windbreaks on these soils is resistance of the species to concentrations of lime.

The soils in this group are suited to caragana, lilac, chokecherry, Russian-olive, and Siberian elm.

WINDBREAK SUITABILITY GROUP 3M

This group consists of soils that have low available water capacity. The available water capacity is limited by shallow soil depth, sandy texture, and rock fragments. Slopes are less than 15 percent. These soils do not have a zone of concentrated lime above a depth of 15 inches, but some of the soils are moderately calcareous in the surface layer.

Salinity, the water table, and wetness are not limitations of these soils. The main consideration in planning farmstead and field windbreaks on these soils is low moisture storage capacity.

The soils in this group are suited to caragana, buffaloberry, Russian-olive, Siberian elm, and Rocky Mountain juniper.

WINDBREAK SUITABILITY GROUP 3W

This group consists of soils that have a water table above a depth of 3 feet during most of the growing season and above a depth of 1 to 2 feet at some time during the season. Slopes are mainly less than 2 percent. During dry seasons water is available in the soil for plants.

Salinity and concentrations of lime are not limitations of these soils. The main consideration in planning farmstead and field windbreaks on these soils is resistance of the species to prolonged wetness.

The soils in this group are suited to purple willow, buffaloberry, Russian-olive, Siberian elm, white willow, golden willow, cottonwood, Colorado blue spruce, and Rocky Mountain juniper.

WINDBREAK SUITABILITY GROUP 4

This group consists of steep, sloping soils, soils that have very low available water capacity, dispersed clays, and very poorly drained soils.

These soils generally are not suited to farmstead and field windbreaks. Many of the soils are mapped in complexes with soils that are suited to windbreaks, especially the hilly and steep soils. Reference to the section "Descriptions of the Soils" and onsite inspections may reveal suitable sites for windbreaks.

Wildlife

The soils, topography, climate, wide variety of native and other suitable kinds of vegetation, and other features combine to favor development of wildlife habitat in this area. These features provide a high potential for managing the land to increase and maintain various kinds of wildlife. The main kinds of game are deer, elk, bear, pronghorn antelope, ring-necked pheasant, gray partridge (Huns), sharp-tailed grouse, ruffed grouse, and blue grouse. Deer, elk, and bear are found mainly in the western, wooded or brush-covered section of the survey area. Pronghorn antelope are mainly in the northeastern and central parts of the area. Pheasants are found mainly in the irrigated area east of Cut Bank and in the area along Birch Creek. Gray partridge (Huns) are found mainly around the grain-producing areas in the eastern part of the survey area. Sharp-tailed, ruffed, and blue grouse are mostly

in the western part of the area; sharptail are in the grassland, and ruffed and blue grouse are in the woodland. Also present are furbearing animals such as raccoon, muskrat, beaver, fox, skunk, and mink. Predators include coyote and bobcat. Numerous species of nongame birds are also present.

The many lakes, some of them quite large, provide an abundance of fishing. Some, such as Duck Lake, have a national reputation for large trout. Others, such as Alkali Lake, are havens for large numbers of migrating geese, ducks, and swans during both spring and fall migrations. When the lakes and marshes do not freeze over early in the season, the area has a high potential for hunting waterfowl. The pothole area of the north and northeast produces the best waterfowl.

Successful management of wildlife on any tract of land requires that food, cover, and water be available in a suitable combination. Lack of any one of these necessities, unfavorable balance between them, or poor distribution may severely limit or account for the absence of desired wildlife species. Soils information provides a valuable tool in creating, improving, or maintaining suitable food, cover, and water for wildlife.

Most wildlife habitats are managed by planting suitable vegetation, by manipulating existing vegetation to bring about natural establishment, increase, or improvement of desired plants, or by combinations of these measures. The influence of a soil on the growth of plants can be predicted from a knowledge of the characteristics and behavior of the soil. In addition, water areas can be created or natural ones improved as wildlife habitat. Soil information is useful for these purposes.

Soil interpretations for wildlife habitat serve a variety of purposes. They are an aid in selecting the more suitable sites for various kinds of management. They indicate the intensity of management needed to achieve satisfactory results. They also serve as a means of showing why it may not be feasible to manage a particular area for a given kind of wildlife.

These interpretations also may serve in broad-scale planning of wildlife management areas, parks, and nature areas, or for acquiring wildlife lands.

The soil areas shown on the soil survey maps are determined by the kind of soil and not by how they may be influenced by adjoining areas. Some influences on habitat, such as elevation and aspect, must be appraised onsite.

Soils directly influence the kinds and amounts of vegetation and amounts of water available, and in this way indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are (1) thickness of soil useful to crops, (2) surface texture, (3) available water capacity, (4) wetness, (5) surface stoniness or rockiness, (6) permeability of the soil to air and water, and (7) salinity or alkalinity, along with flood hazard and slope.

In table 5 soils of this survey area are rated for producing eight elements of wildlife habitat and four kinds of wildlife. The ratings indicate relative suitability for various elements and are expressed by an adjective as follows:

A rating of *good* means habitat is easily improved,

TABLE 5.—*Suitability of soils for elements of*

Series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Absher: Ac -----	Poor	Poor	Very poor		
Adel:					
Ad, Ae -----	Fair	Good	Good		
AB ----- For Babb part, see BF under Babb series.	Poor	Fair	Good		
AF ----- For Fifer part, see Fifer series.	Fair	Good	Good	Good	Good
AL ----- For Hanson part, see Hanson series.	Poor	Fair	Good	Good	Good
Arnegard: Ag, Ah -----	Fair	Fair to good	Fair		
Attewan: Ak, Am, An, Ao -----	Fair	Good	Fair		
Babb:					
Ba -----	Fair	Good	Good		
Bb -----	Poor	Fair	Good		
BC -----	Fair	Good	Good	Good	Good
BF ----- For Hanson part, see Hanson series.	Poor	Fair	Good	Good	Good
Babb variant:					
Bd -----	Fair	Good	Good		
BG -----	Poor	Fair	Good		
Badland: BL. Too variable to rate.					
Bear Lake: Be -----	Poor	Poor	Fair		
Bearmouth: Bg -----	Poor	Poor	Poor		
Beaverton: Bh, Bk ----- For Williams part of Bk, see Wr under Williams series.	Poor	Poor	Poor		
Boxwell: Bo ----- For Cabba part, see Cabba series.	Fair	Good	Fair		
Bridger: BM, BN ----- For Mord part of BM, see Mz under Mord series; Rock land part of BN is too variable to rate.	Poor	Fair	Good		
Brockway: Br, Bs, Bt -----	Fair	Good	Fair		
Burnette:					
Bu -----	Fair	Good	Good		
BP -----	Poor	Fair	Good		
BW ----- For Adel part, see Ae under Adel series.	Fair	Good	Fair		
Bynum:					
Bv -----	Fair	Good	Fair		
By ----- For Fifer part, see Fifer series.	Poor	Fair	Fair		

wildlife habitat and for kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Open-land	Woodland	Wetland	Rangeland
Very poor -----	Poor -----	Very poor -----	Poor -----		Very poor -----	Very poor.
Good -----	Poor to very poor. ¹ -----	Very poor -----	Good -----		Very poor -----	Good.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Good -----	Poor to very poor. ¹ -----	Very poor -----	Good -----	Good -----	Very poor.	
Good -----	Very poor -----	Very poor -----	Fair -----	Good -----	Very poor.	
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Good -----	Poor to very poor. ¹ -----	Very poor -----	Good -----		Very poor -----	Good.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Good -----	Poor to very poor. ¹ -----	Very poor -----	Good -----	Good -----	Very poor.	
Good -----	Very poor -----	Very poor -----	Fair -----	Good -----	Very poor.	
Good -----	Poor to very poor. ¹ -----	Very poor -----	Good -----		Very poor -----	Good.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Fair -----	Good -----	Good to very poor.	Poor -----		Good to poor --	Fair.
Poor -----	Poor -----	Very poor -----	Poor -----		Very poor -----	Poor.
Poor -----	Poor -----	Very poor -----	Poor -----		Very poor -----	Poor.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Good -----	Poor to very poor. ¹ -----	Very poor -----	Good -----		Very poor -----	Good.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.

TABLE 5.—Suitability of soils for elements of

Series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Cabba: Ca, Cb, Ce, CK For Reeder part of Ce, see Reeder series. Rock outcrop part of CK is too variable to rate.	Poor	Poor	Fair		
Castner: Cn, Co For Cabba part, see Cabba series.	Poor	Poor	Poor		
CR	Very poor	Very poor	Poor		
Cheadle	Very poor	Very poor	Poor		
Crago: CV For Kiev part, see Kiev series.	Poor	Fair	Fair		
Dimmick: Dc	Poor	Fair	Poor		
Doby: DH, DL For Burnette part of DH, see BW under Burnette series; for Hanson part of DL, see HF under Hanson series.	Poor	Poor	Poor to fair		
DS Shale outcrop part of DS is too variable to rate.	Very poor	Very poor	Poor to fair		
Dune land: DU. Too variable to rate.					
Ethridge: Ec, Ed, Ee, Eg, Eh, Em For Absher part of Em, see Absher series.	Fair	Good	Fair		
Fairfield: Fa, Fb, Fc, Fd, Fe, Ff, Fg, Fh, Fk For Cabba part of Fh, and Utica part of Fk, see their respective series.	Fair	Good	Fair		
Farnuf: Fm, Fn, Fo, Fr, Fs	Fair	Good to fair	Fair		
Fifer: Ft, FU, FV For Cheadle part of FU, and Raynesford part of FV, see their respective series.	Poor	Poor	Fair to poor		
Fresh water swamp: FW. Too variable to rate.					
Gallatin: Ga	Fair	Fair	Good		
Gapo: Gc	Very poor	Poor	Fair		
Gd	Fair	Good	Good		
Garlet: GL	Very poor	Very poor	Fair	Poor to fair	Poor to fair
Hanson: HA, HF, HR, HS For Fifer part of HF and Raynesford part of HR and HS, see their respective series.	Poor	Fair	Fair		
Kevin: Ka, Kb, Kc, Kd, Ke	Fair	Good	Fair		

wildlife habitat and for kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Open-land	Woodland	Wetland	Rangeland
Fair -----	Poor to very poor. ¹	Very poor -----	Poor -----		Very poor -----	Fair.
Poor -----	Poor to very poor. ¹	Very poor -----	Poor -----		Very poor -----	Poor.
Poor -----	Very poor -----	Very poor -----	Very poor -----		Very poor -----	Poor.
Poor -----	Very poor -----	Very poor -----	Very poor -----		Very poor -----	Poor.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Poor -----	Poor -----	Good to fair -----	Poor -----		Fair to poor -----	Poor.
Poor to fair -----	Poor to very poor. ¹	Very poor -----	Poor -----		Very poor -----	Poor to fair.
Poor to fair -----	Very poor -----	Very poor -----	Poor to very poor.		Very poor -----	Poor to fair.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair to poor -----	Very poor -----	Very poor -----	Poor -----		Very poor -----	Fair to poor.
Good -----	Fair -----	Fair -----	Fair -----		Fair -----	Good.
Fair -----	Good -----	Fair to good -----	Poor -----		Good to fair -----	Fair.
Good -----	Fair -----	Fair -----	Good -----		Fair -----	Good.
Fair -----	Very poor -----	Very poor -----	Poor -----	Poor to fair -----	Very poor.	
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.

TABLE 5.—*Suitability of soils for elements of*

Series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Kiev: Kg, Kh, Kk, Km, Kn, Ko, Kp, Kr -----	Fair -----	Good -----	Fair -----		
Kiwanis:					
Ks -----	Fair -----	Good -----	Fair -----		
Overflow part of Ks -----	Poor -----	Poor -----	Fair -----	Good -----	
Korchea:					
Kt, Ku -----	Fair -----	Good -----	Fair -----		
KV -----	Poor -----	Poor -----	Fair -----	Good -----	
For the Kiwanis part, see Ks under Kiwanis series.					
Kuro: Kw -----	Poor -----	Poor -----	Fair to poor -----		
Leavitt:					
La, Lb, Lc, Ld, Le -----	Fair -----	Good -----	Good -----		
LF -----	Poor -----	Fair -----	Good -----		
Libeg:					
LG -----	Very poor -----	Very poor -----	Fair -----		
LH -----	Poor -----	Fair -----	Fair -----		
Linnet: Lk, Lm, Ln, Lo, Lp -----	Fair -----	Good -----	Poor -----		
Litimber: Lr, Ls, Lt, Lu -----	Fair -----	Good -----	Fair -----		
Loberg:					
LV, LY -----	Poor -----	Fair -----	Good -----	Good -----	Good -----
For Mord part of LV, see Mord series.					
LW -----	Very poor -----	Very poor -----	Good -----	Good -----	Good -----
For Whitore part, see WL under Whitore series.					
Martinsdale: Ma, Mb, Mc, Md, Me, Mf, Mg, Mh, Mk, Mm, Mn -----	Fair -----	Good -----	Fair -----		
Michelson:					
Mo, Mp, Mr, Ms, Mt, Mu, Mv, Mw -----	Fair -----	Good -----	Good -----		
Mx -----	Poor -----	Fair -----	Good -----		
Mikesell: My -----	Poor -----	Fair -----	Fair -----	Good -----	Good -----
Mixed alluvial land: MZb. Too variable to rate.					
Mord:					
Mz -----	Fair -----	Good -----	Good -----	Good -----	Good -----
MZc -----	Poor -----	Fair -----	Good -----		
Nettleton:					
NB -----	Fair -----	Good -----	Fair -----		
For Burnett. part, see Bu under Burnette series.					
NM -----	Poor -----	Fair -----	Fair -----	Good -----	Good -----
For Mikesell part, see Mikesell series.					
Nishon: Nc -----	Poor -----	Fair -----	Poor -----		
Novary: No -----	Very poor -----	Poor -----	Poor -----		
Peat: PA. Too variable to rate.					

wildlife habitat and for kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Open-land	Woodland	Wetland	Rangeland
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Fair -----	Very poor -----	Poor -----		Poor -----	Fair.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor -----	Poor -----	Fair -----		Poor -----	Fair.
Fair to poor ----	Poor to very poor. ¹	Very poor -----	Poor -----		Very poor -----	Fair to poor.
Good -----	Poor to very poor. ¹	Very poor -----	Good -----		Very poor -----	Good.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Fair -----	Very poor -----	Very poor -----	Poor -----		Very poor -----	Fair.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Poor -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Poor.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Good -----	Poor to very poor. ¹	Very poor -----	Fair -----	Good -----	Very poor.	
Good -----	Very poor -----	Very poor -----	Poor -----			Fair.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Good -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Good.
Good -----	Poor -----	Very poor -----	Fair -----	Good -----	Very poor -----	Good.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor.	
Good -----	Poor to very poor. ¹	Very poor -----	Good -----		Very poor -----	Good.
Good -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Good.
Fair -----	Poor -----	Poor to very poor.	Fair -----		Poor to very poor.	Fair.
Fair -----	Very poor -----	Very poor -----	Fair -----	Good -----	Very poor.	
Poor -----	Good -----	Good to fair ----	Poor -----		Good to fair ----	Poor.
Poor -----	Good -----	Fair -----	Poor -----		Fair -----	Poor.

TABLE 5.—Suitability of soils for elements of

Series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Pendroy: Pc, Pd, Pe ----- Pf -----	Fair ----- Poor -----	Good ----- Poor -----	Poor ----- Poor -----		
Pishkun: PH ----- For Adel part, see AF under Adel series.	Poor -----	Fair -----	Fair -----		
Playas: PL. Too variable to rate.					
Raynesford: RC, RD ----- For Bear Lake part of RC and Hanson part of RD, see their respective series.	Poor -----	Fair -----	Good -----		
Redchief: Re, Rf -----	Fair -----	Good -----	Good -----		
Reeder: Rg, Rh ----- For Arnegard part of Rh, see Arnegard series.	Fair -----	Good -----	Fair -----		
Rentsac: RK, Rm, Rn ----- Rock outcrop part of RK is too variable to rate.	Very poor -----	Poor -----	Poor -----		
Rhoades: Ro -----	Poor -----	Poor -----	Very poor -----		
Riverwash: RS. Too variable to rate.					
Rock outcrop: RT. Too variable to rate.					
Saline land: SA. Too variable to rate.					
Savage: Sb, Sc, Sd, Se, Sf ----- For Rhoades part of Se and Wayden part of Sf, see their respective series.	Fair -----	Good to fair -----	Fair -----		
Scobey: Sg, Sh, Sk, Sm, Sn, SO ----- For Kevin part of Sk, Sm, and Sn and Zahl part of SO, see their respective series.	Fair -----	Good -----	Fair -----		
Seeped alluvial land: SP. Too variable to rate.					
Sherburne: Sr -----	Fair -----	Good -----	Good -----	Good -----	Good -----
SS -----	Poor -----	Fair -----	Good -----	Good -----	Good -----
Stony land: ST. Too variable to rate.					
Sunburst: SU -----	Poor -----	Fair -----	Poor -----		
Swifton: SV, SW, SX ----- For Mikesell part of SV, see Mikesell series; for Mord part of SW, see MZc under Mord series; and for Garlet part of SX, see Garlet series. Rock land part of SW is too variable to rate.	Poor -----	Fair -----	Good -----	Good -----	Good -----

wildlife habitat and for kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Open-land	Woodland	Wetland	Rangeland
Poor ----- Poor -----	Poor ----- Poor -----	Very poor ----- Very poor -----	Fair ----- Poor -----		Very poor ----- Very poor -----	Poor. Poor.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Good -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Good.
Good ----- Fair -----	Poor ----- Poor -----	Very poor ----- Very poor -----	Good ----- Fair -----		Very poor ----- Very poor -----	Good. Fair.
Poor -----	Very poor -----	Very poor -----	Poor -----		Very poor -----	Poor.
Very poor -----	Poor -----	Poor to very poor.	Poor -----		Poor to very poor.	Very poor.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Good ----- Good -----	Poor to very poor. ¹ Very poor -----	Very poor ----- Very poor -----	Good ----- Fair -----	Good ----- Good -----	Very poor. Very poor.	
Poor ----- Good -----	Very poor ----- Very poor -----	Very poor ----- Very poor -----	Poor ----- Fair -----		Very poor ----- Very poor.	Poor.

TABLE 5.—Suitability of soils for elements of

Series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Tally: T _a , T _b , T _c -----	Fair -----	Good -----	Fair -----		
TD -----	Poor -----	Fair -----	Fair -----		
Tanna: T _e , T _f , T _g , T _h ----- For Absher part of T _g and Wayden part of T _h , see their respective series.	Fair -----	Good -----	Fair -----		
Tenex: TK -----	Poor -----	Fair -----	Fair to good --	Poor to fair ---	Poor to fair ---
Terrace escarpments: TL. Too variable to rate. For Fairfield part, see Fairfield series.					
Thebo: T _m -----	Poor -----	Poor -----	Poor -----		
Timberg: T _n -----	Fair -----	Good -----	Fair -----		
Tinsley: TN -----	Very poor -----	Very poor -----	Poor -----		
Turner: T _o , T _r , T _s ----- For Beaverton part of T _s , see Beaverton series.	Fair -----	Good -----	Fair -----		
Utica: U _a -----	Poor -----	Poor -----	Poor to fair ---		
Vanda: V _a -----	Poor -----	Poor -----	Poor -----		
Wayden: W _a , W _b , W _c , WD ----- For Absher part of W _c , see Absher series. Shale outcrop part of WD is too variable to rate.	Poor -----	Poor -----	Fair to poor ---		
Wet alluvial land: WE -----	Very poor -----	Poor -----	Fair -----	Poor -----	Poor -----
Wet land: WF -----	Very poor -----	Very poor -----	Very poor -----	Very poor -----	Very poor -----
Whitore: WG -----	Very poor -----	Very poor -----	Fair -----	Poor to fair ---	Poor to fair ---
WH, WL -----	Poor -----	Fair -----	Fair -----	Poor to fair ---	Poor to fair ---
Williams: W _k , W _m , W _r -----	Fair -----	Good -----	Fair -----		
WN, WO, WS, WT ----- For Zahl part of W _r , WS, and WT, see Zahl series.	Poor -----	Fair -----	Fair -----		
Yetull: Y _e -----	Poor -----	Poor -----	Fair -----		
Zahl: ZA -----	Poor -----	Fair -----	Fair -----		

¹ Rating very poor if slopes are more than 8 percent.

maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected.

A rating of *fair* means habitat can be improved, maintained, or created on these soils but moderate soil limitations affect habitat management or development. A moderate intensity of management and

fairly frequent attention may be required to ensure satisfactory results.

A rating of *poor* means habitat can be improved, maintained, or created on these soils, but the soil limitations are severe. Habitat management may be difficult and expensive and may require intensive effort. Results are questionable.

wildlife habitat and for kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Open-land	Woodland	Wetland	Rangeland
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair to good ----	Poor to very poor. ¹	Very poor -----	Fair -----	Fair -----	Very poor.	
Poor -----	Poor -----	Very poor -----	Poor -----		Very poor -----	Poor.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Poor -----	Very poor -----	Very poor -----	Very poor -----		Very poor -----	Poor.
Fair -----	Poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Poor to fair ----	Very poor -----	Very poor -----	Poor -----		Very poor -----	Poor to fair.
Poor -----	Poor -----	Very poor -----	Poor -----		Very poor -----	Poor.
Fair to poor ----	Very poor -----	Very poor -----	Poor -----		Very poor -----	Fair to poor.
Good -----	Good -----	Fair -----	Poor -----		Fair -----	Fair.
Good -----	Good -----	Poor -----	Poor -----		Good -----	Poor.
Fair -----	Very poor -----	Very poor -----	Poor -----	Fair -----	Very poor.	
Fair -----	Very poor -----	Very poor -----	Fair -----	Fair -----	Very poor.	
Fair -----	Poor to very poor. ¹	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Very poor -----	Very poor -----	Fair -----		Very poor -----	Fair.
Fair -----	Poor -----	Very poor -----	Poor -----		Very poor -----	Fair.
Fair -----	Very poor ¹ -----	Very poor -----	Fair -----		Very poor -----	Fair.

A rating of *very poor* means that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

The significance of each heading in table 5 is given in the following paragraphs.

Elements of wildlife habitat. Each soil is rated in

table 5 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection

of a site for development of a habitat for wildlife requires inspection at the site.

Grain and seed crops are annual grain-producing plants such as wheat, barley, and oats.

Domestic grasses and legumes are domestic grasses and legumes that are established by planting. These provide food and cover for wildlife. Examples are ryegrass, crested wheatgrass, sweet clover, alfalfa, and smooth brome grass.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Lupine is a typical example. On rangeland, typical plants are bluestem, grama, perennial forbs, and legumes.

Hardwood trees are nonconiferous trees, shrubs, and woody vines that produce wildlife food in the form of fruits, nuts, buds, catkins, or browse. Such plants commonly grow in their natural environment, but they may be planted and developed through wildlife management programs. Typical species in this category are cottonwood, chokecherry, dogwood, grape, honeysuckle, and silverberry. Soils that do not support hardwood trees as part of their native plant community are not rated.

Coniferous plants are cone-bearing trees and shrubs that provide cover and frequently furnish food in the form of browse, seeds, or fruitlike cones. They commonly grow in their natural environment, but they can be planted and managed. Typical plants in this category are pines, cedars, and ornamental trees and shrubs. Soils that do not support coniferous trees as part of their native plant community are not rated.

Shrubs produce buds, twigs, bark, or foliage used as food by wildlife or provide cover and shade for some wildlife species. These plants commonly grow in their natural environment. Typical plants in this category are bitterbrush, snowberry, rabbitbrush, big sagebrush and greasewood, and shrubby cinquefoil.

Wetland plants are annuals and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples of plants are smartweed, cattail, saltgrass, spikerush, reed canarygrass, and rushes and sedges. Submerged and floating aquatics are not included in this category.

Shallow-water areas are areas of surface water with average depth of less than 5 feet that are useful to wildlife. They may be natural wet areas or those created by dams or levees or by water-control devices in marshes or streams. Typical examples are waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

Kinds of wildlife. Table 5 rates soils according to their suitability as habitat for the 4 kinds of wildlife in the county: open-land, woodland, wetland, and rangeland. These ratings are related to ratings made for the elements of habitat. For example, soils rated as *very poor* for shallow water developments are rated *very poor* for wetland wildlife.

Open-land wildlife consists of birds and mammals of cropland, pasture, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, and red fox.

Woodland wildlife consists of birds and mammals of

wooded areas containing either hardwood or coniferous trees and shrubs or a mixture of both. Examples are wild turkey, blue and ruffed grouse, woodcock, thrushes, vireos, woodpeckers, squirrel, raccoon, mule and white-tailed deer, elk, and black bear. Soils that do not support woodland as part of their native plant community are not rated as habitat for woodland wildlife.

Wetland wildlife consists of birds and mammals of swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, kingfishers, muskrat, mink, beaver, and otter.

Rangeland wildlife consists of birds and mammals of natural rangelands. Examples are pronghorn antelope, white-tailed deer, mule deer, chukar, sage grouse, meadowlark, and lark bunting. Soils that do not support native range plants as part of their native plant community are not rated for rangeland wildlife.

Engineering Uses of the Soils

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 6, 7, and 8, which show, respectively, several estimated soil properties significant in engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in table 7, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths more than those shown in the tables, generally depths more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (13), used by the SCS engineers, Department of Defense, and others, and the AASHTO system (2) adopted by the American Association of State Highway and Transportation Officials.

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. These are 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 are designated by symbols for both classes; for example, ML or CL.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups, ranging from A-1 through A-7, on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet, the poorest soils for subgrade. If laboratory data are available to justify a further breakdown, the A-1, A-2 and A-7 groups are divided 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 engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 8; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in the survey area.

Soil properties significant in engineering

Estimates of several soil properties significant in engineering are given in table 6. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil en-

gineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6. Additional information can be found in the "Guide for Interpreting Engineering Uses of Soils" (12).

Depth to bedrock is distance from the surface of the soil to the upper surface of rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Texture is described in table 6 in the standard terms used by the United States Department of Agriculture (USDA) (10). These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It commonly is defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks when it loses water or swells when it gains water. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or of material having this rating.

Frost action potential is the possible upward or lateral movement of soil resulting from the formation of ice lenses and the subsequent excessive wetting and collapse upon thawing. The formation of ice lenses depends on the capacity of the soil to deliver water to a stationary or slowly moving freezing front. Soils that are high in silt and very fine sand and low in clay have the most potential for frost action if a supply

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series that appear in the first column of

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Percentage larger than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	<i>In</i>	<i>Ft</i>	<i>In</i>				
Absher: Ac -----	>60	>5	0-60	Clay loam -----	CL	A-6	
*Adel: AB, Ad, Ae, AF, AL ----- For Fifer part of AF, Hanson part of AL, Babb part of AB, see these series.	>60	>5	0-40 40-60	Loam ----- Light clay loam ---	ML or OL ML	A-4 A-4	0-10 0-20
Arnegard: Ag, Ah -----	>60	>5	0-11 11-60	Loam ----- Loam -----	OL or ML ML or CL	A-4 A-4 or A-6	
Attewan: Ak, Am, An, Ao -----	>60	>5	0-28 28-60	Sandy clay loam --- Sand -----	CL or SC SW-SM or SP-SM	A-4 or A-6 A-1, A-2, or A-3	
*Babb: Ba, Bb, BC, BF ----- For Hanson part of BF, see Hanson series.	>60	>5	0-60	Cobbly loam or gravelly loam.	ML, SM	A-4	10-30
Babb variant: Bd, BG -----	>60	>5	0-34 34-60	Sandy loam ----- Loamy sand -----	SM SM	A-2 or A-4 A-2	0-10 0-15
Badland: BL ----- Too variable to rate.							
Bear Lake: Be -----	>5	<2	0-45 45-66	Silty clay loam --- Clay or clay loam --	CL CL	A-6 or A-7 A-6 or A-7	
Bearmouth: Bg -----	>120	>5	0-13 13-60	Gravelly loam ----- Very gravelly and cobbly sand.	GM GW	A-2, A-4 A-1	10-30 55-80
*Beaverton: Bh, Bk ----- For Williams part of Bk, see Williams series.	>120	>5	0-14 14-60	Gravelly clay loam - Very gravelly and cobbly sand.	GC or SC GW	A-6 A-1	10-20 20-45
*Boxwell: Bo ----- For Cabba part, see Cabba series.	24-40	>5	0-28 28	Silt loam or silty clay loam. Shale or sandstone.	ML or CL	A-4 or A-6	
*Bridger: BM, BN ----- For Mord part of BM, see Mord series. Rock land part of BN not estimated.	>60	>5	0-34 34-60	Stony clay loam --- Stony clay loam ---	CL SC or SM	A-6 A-4 or A-6	10-15 15-40
Brockway: Br, Bs, Bt -----	>60	>5	0-60	Thinly laminated very fine sandy loam, silty clay loam, and silty clay.	ML or CL	A-4 or A-6	
*Burnett: Bu, BP, BW ----- For Adel part of BW, see Adel series.	>60	>5	0-15 15-66	Loam or stony loam- Clay -----	CL or ML CL or CH	A-6 or A-4 A-7 or A-6	0-30 10-15
*Bynum: Bv, By ----- For Fifer part of By, see Fifer series.	20-40	>5	0-38 38	Silty clay loam --- Shale, siltstone, or sandstone.	CL	A-6	

significant in engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully this table. The symbol < means less than; the symbol > means more than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				<i>In per hr</i>	<i>In per in of soil</i>	<i>pH</i>	<i>mmhos per cm</i>		
90-100	85-100	90-100	60-90	<0.06	0.12-0.18	7.6-9.0	4-16	Moderate -----	Moderate.
85-100	85-100	70-80	60-70	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low -----	Moderate.
85-90	80-90	70-80	60-70	0.6-2.0	0.16-0.20	6.6-7.3	<2	Low -----	Moderate.
-----	100	85-95	60-75	0.6-2.0	0.19-0.21	6.6-7.3	<2	Low -----	Moderate.
-----	100	90-95	65-80	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low -----	Moderate.
90-100	90-100	70-80	45-65	0.6-2.0	0.16-0.18	6.6-7.8	<2	Moderate -----	Moderate.
80-100	75-90	40-60	5-10	>6.0	0.04-0.06	7.9-8.4	<2	Low -----	Low.
85-95	70-80	60-70	45-65	0.6-2.0	0.12-0.15	6.6-7.8	<2	Low -----	Moderate.
95-100	90-100	60-65	30-40	0.6-2.0	0.12-0.16	6.6-8.4	<2	Low -----	Moderate.
95-100	85-95	50-60	15-30	2.0-6.0	0.06-0.08	7.4-7.8	<2	Low -----	Low.
-----	100	95-100	85-95	0.2-0.6	0.16-0.20	7.9-8.4	<4	Moderate -----	High.
-----	100	90-100	75-95	0.06-0.2	0.16-0.20	7.9-8.4	<4	High -----	High.
50-75	35-65	30-60	25-50	6.0-20	0.08-0.10	6.6-7.3	<2	Low -----	Low.
30-45	20-25	15-20	<5	>20	<0.02	7.9-8.4	<2	Low -----	Low.
40-95	30-90	25-85	30-70	0.6-2.0	0.12-0.14	6.6-7.3	<2	Low -----	Moderate.
25-40	20-30	10-20	<5	6.0-20	.02	7.4-7.8	<2	Very low -----	Low.
-----	100	90-100	70-90	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low -----	Moderate.
80-90	75-85	65-75	55-70	0.6-2.0	0.12-0.15	6.6-7.8	<2	Moderate -----	Low.
55-70	45-55	40-50	35-45	0.6-2.0	0.06-0.11	7.4-7.8	<2	Low -----	Low.
-----	100	90-100	60-90	0.2-0.6	0.16-0.18	7.9-8.4	<2	Low -----	Moderate.
85-95	80-90	70-80	50-65	0.6-2.0	0.18-0.20	6.1-6.5	<2	Low -----	Moderate.
85-95	80-90	75-85	65-80	0.2-0.6	0.17-0.19	6.1-7.8	<2	High -----	Moderate.
-----	100	90-100	80-90	0.6-2.0	0.16-0.20	7.4-9.0	<2	Moderate -----	Moderate.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Percentage larger than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	<i>In</i>	<i>Ft</i>	<i>In</i>				
Cabba: Ca, Cb, Ce, CK ----- For Reeder part of Ce, see Reeder series. Rock outcrop part of CK too variable to rate.	<20	>5	0-18 18	Loam ----- Shale and sandstone.	ML or CL	A-4 or A-6	
*Castner: Cn, Co, CR ----- For Cabba part of Cn and Co, see Cabba series. Rock outcrop part of CR too variable to rate.	<20	>5	0-18 18	Channery and flaggy loam or sandy loam. Hard sandstone.	SM, GM	A-2	15-30
Cheadle -----	<20	>5	0-20 20	Flaggy sandy loam. Hard sandstone.	SM	A-2	25-50
*Crago: CV ----- For Kiev part, see Kiev series.	>60	>5	0-60	Very gravelly and cobbly loam.	GM, SM	A-1, A-2	15-40
Dimmick: Dc -----	>60		0-60	Clay -----	CH or CL	A-7	
*Doby: DH, DL, DS ----- For Burnette part of DH and Hanson part of DL, see their respective series. Shale outcrop part of DS too variable to rate.	<20	>5	0-19 19	Shaly clay loam or clay. Shale.	CL or GC	A-6 or A-7	
Dune land: DU. Too variable to rate.							
*Ethrige: Eg, Eh, Em ----- For Absher part of Em, see Absher series.	>60	>5	0-66	Silty clay loam or silty clay.	CL	A-6	
Ethrige, sand substratum: Ec, Ed, Ee -----	>60	>5	0-38 38-68	Clay loam ----- Sand or loamy sand.	CL SM or SP-SM	A-6 A-1, A-2, or A-3	
*Fairfield: Fa, Fb, Fc, Fd, Fe, Ff, Fg, Fh, Fk. For Cabba part of Fb and Utica part of Fk, see their respective series.	>60	>5	0-60	Clay loam or gravelly clay loam.	CL	A-6	0-10
Farnuf: Fm, Fn, Fo, Fr, Fs -----	>48	>5	0-34 34-60	Cobbly loam or clay loam. Gravelly sandy loam or loam.	CL or ML SM or ML	A-6 or A-4 A-2 or A-4	0-25 0-5
*Fifer: Ft, FU, FV ----- For Cheadle part of FU and Raynesford part of FV, see their respective series. Rock outcrop part of FU, too variable to rate.	<20	>5	0-20 20	Loam, clay loam, or silty clay loam. Shale.	ML or CL	A-4 or A-6	
Fresh water swamp: FW. Too variable to rate.							

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
	100	80-100	60-90	<i>In per hr</i> 0.6-2.0	<i>In per in of soil</i> 0.16-0.18	<i>pH</i> 7.4-8.4	<i>mmhos per cm</i> <2	Low -----	Moderate.
45-70	35-60	25-40	15-25	2.0-6.0	0.05-0.10	6.6-8.4	<2	Very low -----	Moderate.
55-80	40-70	25-50	10-30	0.6-2.0	0.05-0.10	6.1-8.4	<2	Very low -----	Moderate.
35-60	25-45	20-40	15-30	0.06-0.2	0.05-0.08	7.4-8.4	<2	Very low -----	Moderate.
	100	95-100	85-100	<0.06	0.18-0.20	7.4-8.4	<2	High -----	Moderate.
100	100	90-100	75-95	0.2-0.6	0.14-0.18	6.6-7.8	<2	Moderate -----	Low.
	100	90-100	85-95	0.2-0.6	0.14-0.20	6.6-8.4	2-4	Moderate -----	Low.
	100	80-90	50-70	0.2-0.6	0.16-0.18	6.6-7.8	<2	Moderate -----	Moderate.
	100	50-70	5-25	6.0-20	0.05-0.08	7.9-8.4	<2	Very low -----	Low.
80-90	60-90	55-80	50-70	0.2-0.6	0.15-0.18	6.6-8.4	1-4	Low -----	Moderate.
90-100	85-100	80-95	60-80	0.6-2.0	0.17-0.19	6.6-8.4	<2	Low -----	Moderate.
80-100	55-100	30-90	15-75	0.6-2.0	0.08-0.18	7.9-8.4	<2	Low -----	Low.
85-100	80-100	75-95	60-90	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low or moderate --	Moderate.

TABLE 6.—Estimated soil properties

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Percentage larger than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	<i>In</i>	<i>Ft</i>	<i>In</i>				
Gallatin: Ga -----	>120	4-5	0-38 38-60	Loam ----- Loam or silty clay loam.	ML or OL ML or CL	A-4 A-6 or A-4	
Gapo: Gc -----	>120	1-3	0-42 42-60	Clay loam or silty clay. Very gravelly sand.	CL GW, GP	A-6 or A-7 A-1	0-5
Gd -----	>60	3-4	0-60	Silty clay -----	CL	A-6 or A-7	
Garlet: GL -----	>60	>5	0-70	Gravelly, cobbly, and stony loam, or sandy clay loam.	GM or SM	A-1 or A-2	30-55
*Hanson: HA, HF, HR, HS ---- For Fifer part of HF and Raynesford part of HR and HS, see their respective series.	>60	>5	0-60	Stony, cobbly, and gravelly loam.	GM or SM	A-4	20-45
Kevin: Ka, Kb, Kc, Kd, Ke ----	>120	>5	0-66	Clay loam, loam, and silty clay loam.	CL	A-6	0-5
Kiev: Kg, Kh, Kk, Km, Kn, Ko, Kp, Kr.	48-120	>5	0-60	Loam or silt loam, and gravelly clay loam.	ML	A-4	
Kiwanis: Ks -----	>120	>5	0-36 36-60	Sandy loam ----- Very gravelly sand.	SM GW or GP	A-4 A-1	0-5
*Korchea: Kt, Ku, KV ----- For Kiwanis part of KV, see Kiwanis series.	60-120	4-5	0-60	Loam, silt loam ----	ML	A-4	
*Kuro: Kw ----- For Timberg part of Kw, see Timberg series.	<20	>5	0-15 15	Clay loam ----- Shale.	CL	A-6	
Leavitt: La, Lb, Lc, Ld, Le, LF --	>60	>5	0-62	Clay loam, cobbly loam.	CL	A-6	0-25
Libeg: LG, LH -----	>60	>5	0-60	Stony, gravelly and cobbly clay loam.	GC or SC	A-2	25-55
Linnet: Lk, Lm, Ln -----	>120	>5	0-76	Clay -----	CL or CH	A-7	
Lo, Lp -----	>120	>5	0-14 14-42 42-60	Clay ----- Gravelly clay loam. Very gravelly sand.	CL or CH CL or SM GW or GP	A-6 or A-7 A-6 A-1	0-5 5-10
Litimber: Lr, Ls, Lt, Lu -----	>60	>5	0-66	Clay loam or cobbly clay loam.	CL	A-6	0-40
*Loberg: LY, LV, LW ----- For Mord part of LV and Whitore part of LW, see their respective series.	>60	>5	0-60	Stony and cobbly clay loam.	SC	A-4 or A-6	15-55

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
	100	85-95	65-75	<i>In per hr</i> 0.6-2.0	<i>In per in of soil</i> 0.19-0.21	<i>pH</i> 7.4-7.8	<i>mmhos per cm</i> <2	Low -----	Moderate.
	100	90-100	70-90	0.06-0.2	0.16-0.18	7.9-8.4	<2	Moderate or low -----	High.
	100	80-90	70-80	0.06-0.2	0.18-0.20	7.9-8.4	1-4	Moderate -----	High.
30-45	20-35	10-25	<5	0.6-2.0	0.03-0.05	7.9-8.4	<2	Low -----	Low.
	100	95-100	80-95	0.06-0.2	0.18-0.20	7.4-8.4	<2	Moderate -----	High.
50-75	30-65	30-40	15-30	6.0-20	0.06-0.10	5.6-8.4	<2	Low -----	Moderate.
40-60	30-50	25-50	20-30	0.2-0.6	0.06-0.10	6.6-8.4	<2	Low -----	Moderate.
90-95	90-95	85-95	60-75	0.06-0.2	0.15-0.17	7.4-8.4	1-4	Moderate -----	Moderate.
85-90	75-85	65-70	50-65	0.6-2.0	0.12-0.15	7.4-8.4	<2	Low -----	Moderate.
20-40	100 15-25	60-70 10-20	30-40 <5	2.0-6.0 >20	0.12-0.14 0.02	6.6-7.8 7.4-8.4	<2 <2	Low ----- Very low -----	Moderate. Low.
	100	80-90	60-80	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low -----	Moderate.
	100	90-100	70-80	0.06-0.2	0.17-0.19	7.4-8.4	1-4	Moderate -----	Low.
90-100	80-90	75-95	60-80	0.6-2.0	0.17-0.19	6.6-8.4	<2	Low -----	Moderate.
50-75	30-65	25-40	20-30	0.6-2.0	0.08-0.10	6.6-7.3	<2	Low -----	Moderate.
	100	90-100	75-95	0.06-0.2	0.15-0.20	6.6-9.0	<2	High -----	Low.
95-100	90-100	85-95	75-90	0.06-0.2	0.18-0.20	6.6-7.3	<2	High -----	Low.
70-80	60-70	55-65	40-55	0.2-0.6	0.14-0.16	7.9-8.4	<2	Moderate -----	Low.
30-40	20-25	10-15	<5	>20	0.01-0.03	7.9-9.0	<2	Very low -----	Low.
95-100	95-100	90-100	70-80	0.6-2.0	0.16-0.18	6.6-8.4	<2	Moderate -----	Moderate.
55-70	50-65	45-60	35-50	0.06-0.2	0.06-0.11	6.1-7.8	<2	Low -----	Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Percentage larger than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	<i>In</i>	<i>Ft</i>	<i>In</i>				
Martinsdale: Ma, Mb, Mc, Md, Me, Mf, Mg, Mh, Mk, Mm, Mn.	>60	>5	0-38 38-68	Gravelly clay loam-- Gravelly sandy clay loam.	CL SC	A-6 A-2, A-4, or A-6	
Michelson: Mo, Mp, Mr, Ms, Mt, Mu, Mv, Mw, Mx.	>48	>5	0-38 38-72	Gravelly or cobbly clay loam or clay loam. Very gravelly sandy clay loam.	CL or SM GC or GM	A-4 or A-6 A-1, A-2	10-45 15-40
Mikesell: My -----	48-84	>5	0-60	Clay loam -----	CL	A-6	0-5
Mixed alluvial land: MZb. Too variable to rate.							
Mord: Mz, MZc -----	>60	>5	0-21 21-60	Loam or stony loam-- Silty clay -----	ML or OL CL	A-4 A-6 or A-7	10-25 10-25
*Nettleton: NB, NM ----- For Burnette part of BN and Mikesell part of NM, see their respective series.	48-120	>5	0-19 19-50 50	Clay loam ----- Clay ----- Shale.	CL or OL CL	A-6 or A-4 A-7	0-5
Nishon: Nc -----	>60	(¹)	0-60	Clay -----	CH or CL	A-7	
Novary: No -----	>120	1-2	0-60	Silt loam, silty clay loam, or gravelly clay loam.	ML, OL, CL	A-4 or A-6	
Peat: PA. Too variable to rate.							
Pendroy: Pc, Pd, Pe, Pf -----	>60	>5	0-60	Clay -----	CH	A-7	
*Pishkun: PH ----- For Adel part of PH, see Adel series.	>60	>5	0-60	Gravelly loam or very gravelly and cobbly loam.	GM or SM	A-1, A-2, or A-4	10-25
Playas: PL. Too variable to rate.							
*Raynesford: RC, RD ----- For Bear Lake part of RC and Hanson part of RD, see their respective series.	>60	>5	0-60	Gravelly and cobbly loam.	SM or ML	A-4	10-25
Redchief: Re, Rf -----	>60	>5	0-13 13-60	Gravelly clay, loam and cobbly loam. Gravelly and very gravelly clay.	GC GC or CL	A-2, A-4 A-2, A-4, or A-6	10-30 5-10
Reeder: Rg, Rh ----- For Arnegard part of Rh, see Arnegard series.	30-40	>5	0-38 38	Silt loam or silty clay loam. Soft shale.	ML or CL	A-4 or A-6	
*Rentsac: RK, Rm, Rn ----- Rock outcrop part of RK too variable to rate.	<20	>5	0-18 18	Stony loam and sandy loam. Hard sandstone.	SM	A-1, A-2	15-40
Rhoades: Ro -----	>48	5-8	0-24 24-60	Clay or clay loam -- Gravelly clay loam--	CL or CH CL or GC	A-6 or A-7 A-6 or A-4	

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
85-90 70-90	70-85 50-75	65-85 40-70	55-65 20-40	0.6-2.0 0.6-2.0	0.15-0.18 0.12-0.17	6.6-8.4 7.9-8.4	<2 <2	Low ----- Low -----	Moderate. Moderate.
65-95	55-90	50-90	35-70	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low -----	Moderate.
30-40	25-35	20-30	15-20	0.6-2.0	0.05-0.08	7.4-7.8	<2	Low -----	Low.
-----	95-100	90-100	70-80	0.2-0.6	0.17-0.19	6.6-7.8	<2	Moderate -----	Moderate.
90-100 90-100	85-95 85-95	75-85 80-95	55-65 70-80	0.6-2.0 0.06-0.2	0.15-0.20 0.15-0.20	6.6-7.3 6.6-7.8	<2 <2	Low ----- Moderate -----	Low. Low.
-----	100 100	90-100 90-100	70-80 75-95	0.6-2.0 0.06-0.2	0.17-0.19 0.18-0.20	6.6-7.3 6.6-8.4	<2 <2	Moderate ----- High -----	Low. Low.
-----	100	90-100	75-95	0.06-0.2	0.16-0.19	6.6-9.0	<2	High -----	High.
60-100	60-100	55-95	35-85	0.6-2.0	0.16-0.21	7.9-8.4	<2	Moderate -----	High.
-----	100	85-95	80-90	<0.06	0.18-0.20	7.4-8.4	1-4	High -----	Low.
30-75	20-75	15-70	15-50	6.0-20	0.06-0.10	7.4-8.4	<2	Low -----	Moderate.
75-85	65-75	55-70	40-55	0.2-0.6	0.11-0.17	6.6-8.4	<2	Low -----	Moderate.
35-80	25-70	20-60	15-50	0.2-0.6	0.10-0.14	5.6-6.0	<2	Moderate -----	Low.
35-80	20-75	20-70	20-65	0.06-0.2	0.10-0.14	5.1-6.0	<2	Moderate -----	Low.
-----	100	90-100	70-90	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low -----	Moderate.
60-70	40-50	25-40	15-25	2.0-6.0	0.05-0.10	7.4-8.4	<2	Very low -----	Moderate.
-----	100 60-75	90-100 55-75	70-90 40-60	<0.06 0.06-0.2	0.16-0.20 0.12-0.14	7.9-9.0 8.5-9.0	4-16 2-8	High ----- Low -----	Low. Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Percentage larger than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	<i>In</i>	<i>Ft</i>	<i>In</i>				
Riverwash: RS. Too variable to rate.							
Rock outcrop: RT. Too variable to rate.							
Saline land: SA. Too variable to rate.							
*Savage: Sb, Sc, Sd, Se, Sf ----- For Rhoades part of Se and Wayden part of Sf, see their respective series.	>60	>5	0-60	Clay loam -----	CL	A-6	
*Scobey: Sg, Sh, Sk, Sm, Sn, SO. For Kevin part of Sk, Sm, and Sn and for Zahl part of SO, see their respective series.	>120	>5	0-60	Clay loam -----	ML or CL	A-4 or A-6	0-5
Seeped alluvial land: SP. Too variable to rate.							
Sherburne: Sr, SS -----	>120	>5	0-18 18-100	Gravelly and cobbly loam. Stony, cobbly, and gravelly clay and clay loam.	ML or SM GC or SM	A-4 A-2, A-4 or A-6	15-40 15-60
Stony land: ST. Too variable to rate.							
Sunburst: SU -----	>60	>5	0-60	Clay -----	CL or CH	A-7 or A-6	
*Swifton: SV, SW, SX ----- For Mikesell part of SV, Mord part of SW, and Garlet part of SC, see their respective series. Rock land part of SW too variable to estimate.	>60	>5	0-22 22-72	Gravelly loam ----- Gravelly sandy clay loam.	SC or CL SC	A-4 A-2 or A-4	0-15 0-15
Tally: Ta, Tb, Tc, TD -----	>60	>5	0-42 42-76	Sandy loam ----- Sand -----	SM SP, SP-SM, or SM	A-2 or A-4 A-2 or A-3	
*Tanna: Te, Tf, Tg, Th ----- For Absher part of Tg and Wayden part of Th, see their respective series.	30-40	>5	0-38 38	Silty clay or clay loam. Platy shale.	CL	A-6	
Tennex: TK -----	>60	>5	0-23 23-60	Cobbly and gravelly clay loam. Cobbly and gravelly sandy loam.	CL or GC GM or SM	A-4 or A-6 A-1	20-30 30-60
*Terrace escarpments: TL. Too variable to rate. For Fairfield part of TL, see Fairfield series.							

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				<i>In per hr</i>	<i>In per in of soil</i>	<i>pH</i>	<i>mmhos per cm</i>		
	100	90-100	70-80	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate -----	Low.
90-95	90-95	85-95	60-75	0.2-0.6	0.15-0.18	6.6-8.4	1-4	Moderate -----	Low.
75-85	70-85	55-75	35-60	0.06-0.2	0.10-0.12	4.5-5.5	<2	Low -----	Low.
40-65	40-55	35-55	30-50	0.06-0.2	0.08-0.10	5.1-6.5	<2	Moderate -----	Low.
95-100	95-100	90-100	75-90	0.06-0.2	0.15-0.19	7.9-8.4	1-4	High -----	Low.
75-85	55-85	50-75	35-55	0.6-2.0	0.10-0.15	4.5-5.5	<2	Low -----	Moderate.
75-85	55-85	45-75	20-40	0.6-2.0	0.10-0.15	5.6-7.8	<2	Low -----	Low.
	100	60-70	30-40	2.0-6.0	0.10-0.15	6.6-8.4	<2	Low -----	Moderate.
	100	50-70	<5-15	>20	0.06-0.09	7.9-8.4	<2	Very low -----	Low.
	100	95-100	85-95	0.06-0.2	0.17-0.19	7.4-8.4	<2	Moderate -----	Low.
65-90	60-85	50-85	40-70	0.6-2.0	0.08-0.10	4.5-5.0	<2	Low -----	Moderate.
40-70	40-55	20-35	15-25	2.0-6.0	0.04-0.06	5.1-6.0	<2	Low -----	Low.

TABLE 6.—Estimated soil properties

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Percentage larger than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	<i>In</i>	<i>Ft</i>	<i>In</i>				
Thebo: Tm -----	30-40	>5	0-32 32	Clay ----- Soft shale.	CH	A-7	
Timberg: Tn -----	30-40	>5	0-12 12-32 32	Clay loam ----- Silty clay ----- Soft shale.	CL CL, CH	A-6 A-6	
Tinsley: TN -----	>120	3-5	0-60	Gravelly or very gravelly and cobbly sand.	GW or SW	A-1	15-50
*Turner: To, Tr, Ts ----- For Beaverton part of Ts, see Beaverton series.	>120	>5	0-26 26-40 40-60	Cobbly loam or clay loam. Very cobbly loamy sand. Very gravelly sand.	CL or ML SW-SM or GW-GM GW or GP	A-6 or A-4 A-1 A-1	0-25 30-45 20-45
Utica: Ua -----	>120	>5	0-18 18-60	Very gravelly sandy loam. Very gravelly sand.	GW-GM or GM GW or GP	A-1 A-1	10-30 15-30
Vanda: Va -----	>60	>5	0-60	Clay -----	CH or CL	A-7	
*Wayden: Wa, Wb, Wc, WD -- For Absher part of Wc, see Absher series. Shale outcrop part of WD not estimated.	<20	>5	0-18 18	Clay loam or silty clay. Soft shale.	CL	A-6 or A-7	
Wet alluvial land: WE. Too variable to rate.							
Wet land: WF. Too variable to rate.							
Whitore: WG, WH, WL -----	>60	>5	0-60	Cobbly, gravelly, and stony clay loam.	GM, GC, SM, or SC	A-4 or A-6	20-50
*Williams: Wk, Wm, WN, WO, Wr, WS, WT. For Zahl part of Wr, WS, and WT, see Zahl series.	>60	>5	0-60	Cobbly loam or clay loam.	ML or CL	A-4 or A-6	10-25
Yetull: Ye -----	>60	>5	0-60	Sand -----	SP or SP-SM	A-3	
*Zahl: ZA -----	>60	>5	0-60	Clay loam -----	ML or CL	A-4 or A-6	0-25

¹ Water ponds on surface of this soil.

of water is within reach of a freezing front. Most of the soils of this survey area have moderate frost action potential.

Corrosivity for uncoated steel and concrete pipe is not given in table 6. Most soils in the survey area have a high corrosivity potential for uncoated steel pipe and a low corrosivity potential for concrete. Corrosivity pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to such properties as drainage, texture, total acidity,

and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon.

Engineering interpretations of the soils

The interpretations in table 7 are based on the estimated engineering properties of soils shown in table

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
95-100	95-100	90-100	75-95	In per hr <0.06	In per in of soil 0.18-0.20	pH 6.6-9.0	mmhos per cm 2-4	High -----	Low.
-----	100	90-100	70-80	0.2-0.6	0.17-0.20	6.6-8.4	2-4	Moderate -----	Low.
-----	100	95-100	90-95	0.2-0.6	0.17-0.20	7.9-9.0	2-4	High -----	Low.
25-60	15-50	10-35	<5	6.0-20	0.02-0.04	6.6-7.3	<2	Very low -----	Low.
85-100	75-100	60-100	50-80	0.6-2.0	0.15-0.18	6.6-8.4	<2	Low -----	Moderate.
50-70	40-60	20-45	5-15	6.0-20	0.05-0.08	7.9-8.4	<2	Low -----	Low.
35-50	25-40	15-30	<5	>20	<0.02	7.4-8.4	<2	Very low -----	Low.
45-50	30-40	25-30	10-15	6.0-20	0.05-0.09	7.4-7.8	<2	Low -----	Low.
40-45	30-35	15-25	<5	>20	0.01-0.04	7.9-8.4	<2	Very low -----	Low.
-----	100	90-100	75-95	<0.06	0.14-0.17	7.9-8.4	4-8	High -----	Low.
-----	100	90-100	70-90	0.06-0.2	0.15-0.18	7.4-8.4	1-4	Moderate or high -----	Low.
50-75	40-70	35-60	35-45	0.6-2.0	0.05-0.08	6.6-8.4	<2	Low -----	Moderate.
85-95	80-90	75-85	65-75	0.2-0.6	0.15-0.18	6.6-8.4	<2	Moderate -----	Moderate.
90-95	90-95	40-60	<5-10	6.0-20	0.05-0.09	7.4-7.8	<2	Low -----	Low.
75-95	65-85	60-80	50-65	0.2-0.6	0.14-0.17	7.4-8.4	1-4	Moderate -----	Moderate.

6, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the survey area. In table 7 ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for pond reservoir areas; embankments, dikes and levees; irrigation and terraces, diversions, and waterways. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight,

moderate, and severe. *Slight* means soil properties generally favorable for the rated use, or, in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings approxi-

TABLE 7.—*Interpretations of engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. fully the instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Absher: Ac -----	Severe: very slow permeability.	Moderate: clay loam texture; hard to work when wet.	Moderate: moderate shrink-swell potential; low shear strength.	Moderate: moderate shrink-swell potential; moderate frost action potential; low shear strength.	Severe: low shear strength.	Moderate: muddy when wet; dusty when dry; clay loam texture.
*Adel: AB, Ad, Ae, AF, AL ----- For Fifer part of AF, Hanson part of AL, and Babb part of AB, see their respective series.	Slight if slopes are 0 to 8 percent: moderate permeability. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: low or medium shear strength. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential; low or medium shear strength. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: low or medium shear strength. Severe if slopes are 15 to 35 percent.	Slight if slopes are 0 to 15 percent. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 35 percent.
Arnegard: Ag, Ah -----	Slight or moderate: moderate permeability.	Slight -----	Slight or moderate: medium to low shear strength.	Moderate: moderate frost-action potential.	Moderate: moderate frost-action potential; medium to low shear strength.	Slight -----
Attewan: Ak, Am, An, Ao -----	Slight ¹ -----	Severe: sand at a depth of 40 inches or less; unstable walls.	Moderate: moderate shrink-swell potential.	Moderate: moderate frost-action potential; moderate shrink-swell potential.	Moderate: moderate frost-action potential; moderate shrink-swell potential.	Slight -----
*Babb: Ba, Bb, BC, BF ----- For Hanson part of BF, see Hanson series.	Slight if slopes are 2 to 8 percent: moderate permeability. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Slight if slopes are 2 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: medium shear strength. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential; medium shear strength. Severe if slopes are 15 to 35 percent.	Slight or moderate if slopes are 2 to 15 percent: 10 to 30 percent small stones. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 35 percent.

properties of the soils

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow care—that appear in the first column of this table]

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Moderate: muddy when wet; dusty when dry; clay loam texture; slow permeability.	Poor: low shear strength.	Unsuited ----	Poor: high or moderate alkalinity.	Favorable ---	Low shear strength; medium compressibility; medium or low susceptibility to piping.	Slow permeability; high or moderate alkalinity.	Soil is hard to work and vegetate.
Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are more than 15 percent.	Fair if slopes are 15 to 25 percent: low shear strength. Poor if slopes are 25 to 35 percent.	Unsuited ----	Fair if slopes are 8 to 15 percent: 0 to 15 percent small stones. Poor if slopes are 15 to 35 percent.	Moderate permeability; slopes of 0 to 35 percent.	Low or medium shear strength; medium compressibility; fair or poor compaction characteristics.	Complex slopes of 0 to 35 percent.	Complex slopes of 0 to 35 percent.
Slight -----	Fair: moderate frost-action potential; medium to low shear strength.	Unsuited ----	Good to a depth of 36 inches. Fair between depths of 36 and 60 inches: calcareous.	Moderate permeability.	Medium to low shear strength; medium compressibility; fair to good compaction characteristics.	Slopes of 0 to 8 percent.	Favorable.
Slight -----	Fair to a depth of 28 inches: moderate frost-action potential; moderate shrink-swell potential. Good below a depth of 28 inches.	Good in areas. Fair in places below a depth of 28 inches: 5 to 10 percent fines.	Good to a depth of 28 inches. Poor below a depth of 28 inches: gravelly or sandy.	Very rapid permeability below a depth of 28 inches.	Medium susceptibility to piping above a depth of 28 inches; sand below a depth of 40 inches; high compacted permeability.	Very rapid permeability below a depth of 28 inches.	Sand below a depth of 28 inches is erodible and hard to vegetate.
Slight or moderate if slopes are 2 to 8 percent: 10 to 30 percent small stones. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Fair if slopes are 15 to 25 percent: moderate frost-action potential; medium shear strength. Poor if slopes are 25 to 35 percent.	Unsuited ----	Poor if slopes are 15 to 30 percent: small stones; local areas are good. Poor if slopes are 15 to 35 percent.	Moderate permeability; slopes of 2 to 35 percent.	Medium shear strength and compressibility; fair to poor compaction characteristics.	Slopes of 2 to 35 percent; 10 to 30 percent small stones.	Short complex slopes of 2 to 35 percent in some areas; 10 to 30 percent small stones.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Babb variant: Bd, BG -----	Slight if slopes are 2 to 8 percent; moderately rapid permeability below a depth of 2 feet. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Severe: loamy sand below a depth of 34 inches; unstable walls; 15 to 35 percent slopes.	Slight if slopes are 2 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Slight if slopes are 2 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent; moderate frost-action potential. Severe if slopes are 15 to 35 percent.	Slight if slopes are 2 to 15 percent. Moderate if slopes are 15 to 35 percent. Severe if slopes are 25 to 35 percent.
Badland: BL. Too variable for interpretation.						
Bear Lake: Be -----	Severe: water table at a depth of less than 2 feet; moderately slow and low permeability.	Severe: water table at a depth of less than 2 feet; poorly drained.	Severe: water table at a depth of less than 2 feet; poorly drained.	Severe: poorly drained; high frost action potential.	Severe: poorly drained; high frost action potential; low shear strength.	Moderate or severe: water table at a depth of less than 2 feet during use period; poorly drained.
Bearmouth: Bg -----	Slight ¹ -----	Severe: very gravelly and cobbly; difficult to dig; unstable walls.	Slight -----	Slight -----	Slight -----	Moderate: small stones.
*Beaverton: Bh, Bk ----- For Williams part of Bk, see Williams series.	Slight ¹ -----	Severe: small stones; difficult to dig; unstable walls.	Slight -----	Slight -----	Moderate: moderate frost action potential.	Moderate: small stones.
*Boxwell: Bo ----- For Cabba part, see Cabba series.	Severe: shale or sandstone at a depth of 24 to 40 inches.	Moderate: shale or sandstone at a depth of 24 to 40 inches.	Moderate: shale or sandstone at a depth of 24 to 40 inches; medium to low shear strength.	Moderate: moderate frost-action potential; medium to low shear strength.	Moderate: moderate frost-action potential; medium to low shear strength.	Slight -----
*Bridger: BM, BN ----- For Mord part of BM, see Mord series; Rockland part of BN too variable for interpretation.	Moderate if slopes are 8 to 15 percent; large stones. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent; large stones; clay loam texture. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent; large stones; low shear strength. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent; large stones; low shear strength. Severe if slopes are 15 to 40 percent.	Severe if slopes are 15 to 60 percent; low shear strength.	Moderate if slopes are 15 to 25 percent; large stones; low shear strength. Severe if slopes are 25 to 40 percent.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Slight if slopes are 2 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Fair if slopes are 15 to 25 percent: moderate frost-action potential. Poor if slopes are 25 to 35 percent.	Unsuited ----	Good to fair: 2 to 10 percent small stones.	Moderate to moderately rapid permeability; slopes of 2 to 35 percent.	Medium shear strength; low or medium compressibility; medium or low compacted permeability.	Complex slopes of 2 to 35 percent.	Complex slopes of 2 to 35 percent; deep cuts hard to vegetate and erodible.
Moderate or severe: water table at a depth of less than 2 feet during use period; poorly drained.	Poor: poorly drained; high frost action potential; low shear strength.	Unsuited ----	Poor: poorly drained.	All features favorable.	Wet soil; low shear strength; medium compressibility; fair to good compaction characteristics.	Poorly drained soil; moderately slow and slow permeability.	Poorly drained; hard to work and vegetate.
Moderate: small stones.	Good -----	Good for gravel.	Poor: more than 25 percent small stones.	Very rapid permeability.	High compacted permeability.	Very low available water capacity; 25 to 90 percent small stones.	25 to 90 percent small stones difficult to vegetate.
Moderate: small stones.	Good -----	Good for gravel.	Poor: more than 15 percent small stones.	Moderate and rapid permeability.	High compacted permeability.	Very low available water capacity; 10 to 80 percent small stones.	10 to 80 percent small stones; difficult to work and vegetate.
Slight -----	Fair: less than 40 inches of material; medium to low shear strength.	Unsuited ----	Fair to poor: shale or sandstone at a depth of 24 to 40 inches.	Shale or sandstone at a depth of 24 to 40 inches.	Medium to low shear strength; medium compressibility; shale or sandstone at a depth of 20 to 40 inches.	Shale or sandstone at a depth of 24 to 40 inches.	Deep cuts difficult to vegetate.
Moderate if slopes are 8 to 15 percent: large stones. Severe if slopes are 15 to 40 percent.	Poor: 25 to 60 percent slopes; low shear strength.	Unsuited ----	Poor: 15 to 60 percent slopes; large stones.	Moderate permeability; slopes of 4 to 40 percent.	Low shear strength; medium compressibility; large stones.	Slopes of 4 to 40 percent; large stones.	Complex slopes of 4 to 40 percent; large stones hinder grading.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Brockway: Br, Bs, Bt -----	Severe: moderately slow permeability.	Slight -----	Moderate: medium or low shear strength.	Moderate: moderate frost action potential; medium or low shear strength.	Moderate: moderate frost action potential; medium or low shear strength.	Slight -----
*Burnette: Bu, BP, BW ----- For Adel part of BW, see Adel series.	Severe: moderately slow permeability; 15 to 25 percent slopes.	Severe: clay is sticky if wet; hard to work; 15 to 25 percent slopes.	Severe: clay hard to dig; high shrink-swell potential; 15 to 25 percent slopes.	Severe: high shrink-swell potential; 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes; low shear strength.	Slight if slopes are 0 to 15 percent. Moderate if slopes are 15 to 25 percent.
*Bynum: Bv, By ----- For Fifer part of By, see Fifer series.	Severe: shale, siltstone, or sandstone at a depth of 20 to 40 inches.	Moderate: shale, siltstone, or sandstone at a depth of 20 to 40 inches.	Moderate: shale, siltstone, or sandstone at a depth of 20 to 40 inches; moderate shrink-swell potential; low shear strength.	Moderate: moderate frost action potential; moderate shrink-swell potential; low shear strength.	Severe: low shear strength.	Slight -----
*Cabba: Ca, Cb, Ce, CK ----- For Reeder part of Ce, see Reeder series; Rock outcrop part of CK too variable for interpretation.	Severe: soft shale or sandstone at a depth of less than 20 inches; 15 to 50 percent slopes.	Moderate if slopes are 8 to 15 percent: soft shale or sandstone at a depth of less than 20 inches. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent: moderate frost action potential; soft shale or sandstone at a depth of less than 20 inches. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent: moderate frost action potential; medium or low shear strength. Severe if slopes are 15 to 50 percent.	Slight if slopes are 2 to 15 percent. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 50 percent.
*Castner: Cn, Co, CR ----- For Cabba part of Co and Cn, see Cabba series; Rock outcrop part of CR too variable for interpretation.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Moderate if slopes are 15 to 25 percent: small stones. Severe if slopes are 25 to 60 percent.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Slight -----	Fair: moderate frost action potential; medium or low shear strength.	Unsuited ----	Fair to a depth of 11 inches. Poor below a depth of 11 inches: high content of lime.	Moderately slow permeability; slopes of 0 to 8 percent.	Medium or low shear strength; medium compressibility; high susceptibility to piping.	Moderately slow permeability; slopes of 0 to 8 percent.	Deep cuts hard to vegetate; erodible.
Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Poor: high shrink-swell potential; low shear strength.	Unsuited ----	Fair to poor: small stones; thin layer.	Slopes of 0 to 25 percent.	Medium compressibility; low shear strength; low compacted permeability.	Moderate permeability above a depth of 15 inches and moderately slow permeability below a depth of 15 inches; small stones.	Clay below a depth of 15 inches; hard to work and vegetate; small stones.
Slight -----	Poor: low shear strength; less than 40 inches of material.	Unsuited ----	Fair to poor: silty clay loam over shale, siltstone or sandstone at a depth of 20 to 40 inches.	Shale, siltstone or sandstone at a depth of 20 to 40 inches.	Low shear strength; medium compressibility; low or medium susceptibility to piping; shale, siltstone, or sandstone at a depth of 20 to 40 inches.	Shale, siltstone, or sandstone at a depth of 20 to 40 inches.	Shale, siltstone, or sandstone at a depth of 20 to 40 inches; cuts hard to vegetate.
Slight if slopes are 2 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 50 percent.	Poor: 25 to 50 percent slopes; less than 20 inches of material.	Unsuited ----	Poor: soft shale or sandstone at a depth of less than 20 inches.	Soft shale or sandstone at a depth of less than 20 inches.	Limited material; medium or low shear strength; medium compressibility; high susceptibility to piping.	Soft shale or sandstone at a depth of less than 20 inches.	Soft shale or sandstone at a depth of less than 20 inches; cuts hard to vegetate.
Moderate if slopes are 8 to 15 percent: small stones. Severe if slopes are 15 to 60 percent.	Poor: 25 to 60 percent slopes; sandstone at a depth of less than 20 inches.	Unsuited ----	Poor: 15 to 60 percent slopes; small stones; sandstone at a depth of less than 20 inches.	Pervious sandstone at a depth of less than 20 inches; slopes of 2 to 60 percent.	Sandstone at a depth of less than 20 inches; good to fair compaction characteristics; slopes of 2 to 60 percent.	Sandstone at a depth of less than 20 inches; slopes of 2 to 60 percent.	Sandstone at a depth of less than 20 inches; slopes of 2 to 60 percent.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Cheadle -----	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Moderate if slopes are 15 to 25 percent: small stones. Severe if slopes are 25 to 60 percent.
*Crago: CV ----- For Kiev part, see Kiev series.	Severe: slow permeability; 15 to 50 percent slopes.	Severe: small stones; 15 to 60 percent slopes.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent: moderate frost action potential. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent: moderate frost action potential. Severe if slopes are 15 to 50 percent.	Severe: small stones; 25 to 50 percent slopes.
Dimmick: Dc -----	Severe: surface ponding; very slow permeability.	Severe: very poorly drained; surface ponding; clayey.	Severe: very poorly drained; surface ponding; high shrink-swell potential.	Severe: very poorly drained; surface ponding; high shrink-swell potential.	Severe: high shrink-swell potential; surface ponding; very poorly drained.	Severe: very poorly drained.
*Doby: DH, DL, DS ----- For Burnette part of DH and Hanson part of DL, see their respective series; Shale outcrop part of DS too variable for interpretation.	Severe: soft shale at a depth of less than 20 inches; moderately slow permeability; 15 to 60 percent slopes.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches; moderate shrink-swell potential. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches; moderate shrink-swell potential. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential; low to medium shear strength. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 15 to 25 percent: clay loam surface layer. Severe if slopes are 25 to 60 percent.
Dune land: DU. Too variable for interpretation.						
*Ethridge: Ec, Ed, Ee -----	Slight: ¹ rapid permeability below a depth of 38 inches; moderately slow permeability above a depth of 38 inches.	Severe: unstable walls; sand or loamy sand below a depth of 38 inches.	Slight -----	Moderate: moderate shrink-swell potential; low shear strength.	Severe: low shear strength.	Moderate: clay loam surface layer.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Moderate if slopes are 8 to 15 percent: small stones. Severe if slopes are 15 to 60 percent.	Poor: 25 to 60 percent slopes; sandstone at a depth of less than 20 inches.	Unsuited ----	Poor: small stones; 15 to 60 percent slopes; sandstone at a depth of less than 20 inches.	Pervious sandstone at a depth of less than 20 inches; slopes of 15 to 60 percent.	Sandstone at a depth of less than 20 inches; good to fair compaction characteristics; slopes of 15 to 60 percent.	Sandstone at a depth of less than 20 inches; slopes of 15 to 60 percent.	Sandstone at a depth of less than 20 inches; slopes of 15 to 60 percent.
Severe: small stones; 15 to 50 percent slopes.	Good if slopes are 8 to 15 percent. Fair if slopes are 15 to 25 percent. Poor if slopes are 25 to 50 percent.	Poor: 15 to 30 percent fines.	Poor: small stones; 15 to 50 percent slopes.	Slopes of 8 to 50 percent.	Medium to low compacted permeability; medium to low piping; fair to good compaction characteristics.	Low available water capacity; small stones; slopes of 8 to 50 percent; slow permeability.	Small stones; difficult to vegetate; slopes of 8 to 50 percent.
Severe: very poorly drained.	Poor: very poorly drained; high shrink-swell potential; low strength.	Unsuited ----	Poor: clayey; very poorly drained.	All features favorable.	High compressibility; poor compaction characteristics; low strength.	Very poorly drained; heavy clay.	Very poorly drained clay soil; poor outlets.
Moderate if slopes are 8 to 15 percent: clay loam surface layer. Severe if slopes are 15 to 60 percent.	Poor: 25 to 60 percent slopes; soft shale at a depth of less than 20 inches.	Unsuited ----	Poor: 15 to 60 percent slopes; clay texture; soft shale at a depth of less than 20 inches.	4 to 60 percent slopes; soft shale at a depth of less than 20 inches.	Limited material; low to medium compressibility and shear strength.	Soft shale at a depth of less than 20 inches; moderately slow permeability.	Soft shale at a depth of less than 20 inches; clay soil difficult to vegetate.
Moderate: clay loam surface layer.	Poor above a depth of 38 inches: low shear strength. Good below a depth of about 38 inches.	Fair or poor: sand source below a depth of 38 inches; SP-SM or SM material.	Poor: silty clay loam over silty clay.	Rapid permeability below a depth of about 38 inches.	Low shear strength; medium compressibility; sand below a depth of about 38 inches.	Sand below a depth of about 38 inches.	Deep cuts expose erodible sand; susceptibility to piping.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
*Ethridge— <i>con't.</i> Eg, Eh, Em ----- For Absher part of Em, see Absher series.	Severe: moderately slow permeability.	Slight -----	Moderate: moderate shrink-swell potential; low shear strength.	Moderate: moderate shrink-swell potential; low shear strength.	Severe: low shear strength.	Moderate: silty clay loam surface layer.
*Fairfield: Fa, Fb, Fc, Fd, Fe, Ff, Fg, Fh, Fk. For Cabba part of Fh and Utica part of Fk, see their respective series.	Severe: ¹ moderately slow permeability.	Moderate: clay loam material is sticky and difficult to dig when wet.	Moderate: low shear strength.	Moderate: low shear strength; frost action potential.	Severe: low shear strength.	Slight if less than 20 percent small stones. Moderate if 20 to 30 percent small stones.
Farnuf: Fm, Fn, Fo, Fr, Fs -----	Slight or moderate: moderate permeability; 0 to 15 percent slopes.	Moderate: 8 to 15 percent slopes; small stones.	Slight or moderate: medium to low shear strength; 0 to 15 percent slopes.	Slight or moderate: medium or low shear strength; 0 to 15 percent slopes.	Moderate: medium or low shear strength; 8 to 15 percent slopes.	Slight or moderate: small stones.
*Fifer: Ft, FU, FV ----- For Cheadle part of FU and Raynesford part of FV, see their respective series.	Severe: soft shale at a depth of less than 20 inches; 15 to 60 percent slopes.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: soft shale at a depth of less than 20 inches. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: medium or low shear strength. Severe if slopes are 15 to 60 percent.	Slight if slopes are 8 to 15 percent. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 60 percent.
Fresh water swamp: FW. Too variable for interpretation.						
Gallatin: Ga -----	Severe: ¹ slow permeability.	Severe: somewhat poorly drained.	Severe: rare flooding hazard.	Severe: rare flooding hazard.	Severe: low shear strength.	Moderate: somewhat poorly drained.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Moderate: silty clay loam surface layer.	Poor: low shear strength.	Unsuited ----	Poor: silty clay loam over silty clay.	Moderately slow permeability.	Low shear strength; medium compressibility; fair to good compaction characteristics.	Moderately slow permeability.	High lime substratum hard to vegetate.
Slight if less than 20 percent small stones. Moderate if 20 to 30 percent small stones.	Poor: low shear strength.	Unsuited: gravel likely at a depth of 6 feet or less in Fa, Fd, and Fg.	Fair or poor: 5 to 30 percent small stones.	Moderately slow permeability; slopes of 0 to 8 percent.	Low shear strength; medium compressibility; fair or good compaction characteristics.	Moderately slow permeability; 5 to 30 percent small stones; slopes of 0 to 8 percent.	High lime substratum hard to vegetate; slopes of 0 to 8 percent; 5 to 30 percent small stones.
Slight or moderate: small stones; 0 to 15 percent slopes.	Fair: medium or low shear strength; 8 to 15 percent slopes.	Unsuited ----	Fair or poor: 8 to 15 percent slopes; 0 to 20 percent small stones.	Moderate permeability; slopes of 0 to 15 percent.	Medium or low shear strength; medium compressibility; low to high susceptibility to piping.	Slopes of 0 to 15 percent; 20 percent small stones in Fn, Fo, Fr, Fs.	Slopes of 0 to 15 percent; susceptibility to piping.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 60 percent.	Poor: 25 to 60 percent slopes; thin layer; soft shale at a depth of less than 20 inches.	Unsuited ----	Poor: 15 to 60 percent slopes; thin layer; soft shale at a depth of less than 20 inches.	Slopes of 8 to 60 percent; soft shale at a depth of less than 20 inches.	Thin layer over soft shale; medium to low shear strength; medium compressibility.	Soft shale at a depth of less than 20 inches; slopes of 8 to 60 percent.	Soft shale at a depth of less than 20 inches; slopes of 8 to 60 percent.
Moderate: somewhat poorly drained; rare flooding hazard.	Poor: low shear strength.	Unsuited ----	Good above a depth of 26 inches. Fair or good at a depth of 26 to 60 inches.	All features favorable.	Medium or high compressibility; low shear strength; good or poor compaction characteristics.	Somewhat poorly drained; slow permeability.	Somewhat poorly drained.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Gapo: Gc -----	Severe: ¹ seasonal water table at a depth of 1 to 3 feet.	Severe: seasonal water table at a depth of 1 to 3 feet; unstable walls; very gravelly sand below a depth of 40 inches; poorly drained.	Severe: seasonal water table at a depth of 1 to 3 feet; poorly drained.	Severe: seasonal water table at a depth of 1 to 3 feet; high frost-action potential; poorly drained.	Severe: poorly drained; high frost-action potential; low shear strength.	Severe: poorly drained; seasonal water table at a depth of 1 to 3 feet.
Gd -----	Severe: seasonal water table at a depth of 3 to 4 feet; slow permeability.	Severe: seasonal water table at a depth of 3 to 4 feet; silty clay material; sticky when wet; hard to work.	Severe: seasonal water table at a depth of 3 to 4 feet.	Severe: high frost-action potential; seasonal high water table at a depth of 3 to 4 feet.	Severe: high frost action potential; low shear strength; seasonal water table at a depth of 3 to 4 feet.	Moderate: seasonal water table at a depth of 3 to 4 feet.
Garlet: GL -----	Severe: 25 to 60 percent slopes.	Severe: 25 to 60 percent slopes.	Severe: 25 to 60 percent slopes.	Severe: 25 to 60 percent slopes.	Severe: 25 to 60 percent slopes.	Severe: 25 to 60 percent slopes.
*Hanson: HA, HF, HR, HS ---- For Fifer part of HF and Raynesford part of HR and HS, see their respective series.	Severe: moderately slow permeability; 15 to 35 percent slopes.	Moderate if slopes are 8 to 15 percent: small and large stones. Severe if slopes are 15 to 35 percent.	Slight if slopes are 4 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 15 to 25 percent: 40 to 50 percent small and large stones on surface. Severe if slopes are 25 to 35 percent: 40 to 70 percent small and large stones on surface.
Kevin: Ka, Kb, Kc, Kd, Ke ----	Severe: slow permeability.	Moderate: clay loam is sticky when wet and hard when dry; 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes; low shear strength; moderate shrink-swell potential.	Moderate: 8 to 15 percent slopes; moderate frost-action potential; moderate shrink-swell potential; low shear strength.	Severe: low shear strength.	Slight: loam surface layer. Moderate: clay loam and silty clay loam surface layer.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Severe: poorly drained; seasonal water table at a depth of 1 to 3 feet.	Poor: poorly drained; high frost-action potential; low shear strength.	Good or fair: gravel and sand below a depth of 40 inches; less than 5 percent fines.	Poor: poorly drained; silty clay texture.	Rapid permeability below a depth of 40 inches; seasonal water table at a depth of 1 to 3 feet.	Medium compressibility; low shear strength; low or medium compacted permeability.	Poorly drained; slow permeability above a depth of 40 inches; seasonal water table at a depth of 1 to 3 feet.	Poorly drained; slow permeability above a depth of 40 inches; seasonal water table at a depth of 1 to 3 feet.
Moderate: seasonal water table at a depth of 3 to 4 feet.	Poor: low shear strength; high frost-action potential.	Unsuited ----	Poor: silty clay texture.	All features favorable.	Medium compressibility; low shear strength; low or medium compacted permeability.	Slow permeability; seasonal water table at a depth of 3 to 4 feet.	Seasonal water table at a depth of 3 to 4 feet.
Severe: 25 to 60 percent slopes.	Poor: 25 to 60 percent slopes.	Poor: 15 to 30 percent fines; 40 to 75 percent small and large stones.	Poor: 25 to 60 percent slopes; 40 to 75 percent small and large stones.	Rapid permeability; slopes of 25 to 60 percent.	Medium to high shear strength; medium to low compacted permeability.	40 to 75 percent small and large stones; slopes of 25 to 60 percent.	Slopes of 25 to 60 percent; 40 to 75 percent small and large stones.
Moderate if slopes are 8 to 15 percent: 40 to 50 percent small and large stones on surface. Severe if slopes are 15 to 35 percent: 40 to 70 percent small and large stones on surface.	Fair if slopes are 15 to 25 percent: moderate frost-action potential. Poor if slopes are 25 to 35 percent.	Poor: 20 to 30 percent fines.	Poor: more than 40 to 70 percent small and large stones.	Slopes of 2 to 35 percent; moderately slow permeability.	Fair or good compaction characteristics; medium or low compacted permeability; low compressibility.	More than 40 to 70 percent small and large stones; moderately slow permeability.	More than 40 to 70 percent small and large stones; cuts hard to vegetate.
Slight if slopes are 2 to 8 percent: loam surface layer. Moderate if slopes are 8 to 15 percent: clay loam and silty clay loam surface layer.	Poor: low shear strength.	Unsuited ----	Fair: 8 to 15 percent slopes; clay loam and silty clay loam material; high content of lime below a depth of 10 inches.	Slopes of 2 to 15 percent.	Low shear strength; medium compressibility; fair or good compaction characteristics.	Slow permeability; complex slopes of 2 to 15 percent.	Complex slopes of 2 to 15 percent.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Kiev: Kg, Kh, Kk, Km, Kn, Ko, Kp, Kr.	Moderate: moderate permeability; 8 to 15 percent slopes; soft shale at a depth of 48 to 60 inches in Kh, Kk, and Km.	Moderate: hard to dig when dry; hard to work when wet and sticky; 8 to 15 percent slopes.	Moderate: medium or low shear strength.	Moderate: moderate frost-action potential; medium or low shear strength.	Moderate: moderate frost-action potential; medium or low shear strength.	Slight -----
Kiwanis: Ks -----	Slight: fluctuating water table at a depth of more than 5 feet.	Severe: very gravelly sand at a depth of 36 inches; unstable walls.	Moderate: water table at a depth of more than 5 feet. Severe where flooding is a hazard.	Slight if no flood hazard. Severe where flooding is a hazard.	Moderate: moderate frost-action potential; medium shear strength.	Slight -----
*Korchea: Kt, Ku, KV ----- For Kiwanis part of KV, see Kiwanis series.	Slight or moderate: moderate permeability. Severe where flooding is a hazard.	Moderate: seasonal high water table at a depth of 4 to 5 feet. Severe where flooding is a hazard.	Moderate: seasonal high water table at a depth of 4 to 5 feet; medium or low shear strength. Severe where flooding is a hazard.	Moderate: moderate frost-action potential; medium or low shear strength. Severe in areas subject to flooding.	Moderate: moderate frost-action potential; medium or low shear strength.	Slight -----
*Kuro: Kw ----- For Timberg part, see Timberg series.	Severe: slow permeability; soft shale within a depth of 20 inches.	Moderate: soft shale within a depth of 20 inches; 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes; soft shale within a depth of 20 inches; low shear strength; moderate shrink-swell potential.	Moderate: 8 to 15 percent slopes; soft shale at a depth of less than 20 inches; moderate shrink-swell potential; low shear strength.	Severe: low shear strength.	Moderate: clay loam surface layer.
Leavitt: La, Lb, Lc, Ld, Le, LF -	Slight or moderate: moderate permeability. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: clay loam material; small stones. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: low shear strength. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential; low shear strength. Severe if slopes are 15 to 35 percent.	Severe: 15 to 35 percent slopes; low shear strength.	Moderate if slopes are 15 to 25 percent: small stones. Severe if slopes are 25 to 35 percent.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent.	Fair: moderate frost-action potential; medium or low shear strength.	Unsuited: gravel likely within a depth of 6 feet in K _n .	Fair: 10 to 15 percent small stones.	Moderate permeability; slopes of 2 to 15 percent.	Medium compressibility; medium or low shear strength; fair or poor compaction characteristics.	Slopes of 2 to 15 percent.	Cuts are hard to vegetate; high content of lime; low fertility; slopes of 2 to 15 percent.
Slight if no flood hazard. Severe where flooding is a hazard.	Fair: medium shear strength; moderate frost-action potential. Good below a depth of 3 feet.	Poor: sand at a depth of 0 to 36 inches; 35 to 50 percent fines. Good gravel below a depth of 36 inches.	Good above a depth of 36 inches. Poor below a depth of 36 inches: small stones.	Very rapid permeability below a depth of 24 to 40 inches; water table at a depth of 3 to 5 feet.	Medium compressibility; high compacted permeability below a depth of 24 to 40 inches.	Low available water capacity; water table at a depth of more than 5 feet.	Deep cuts expose gravel; hard to vegetate; water table at a depth of 3 to 5 feet.
Slight if no flood hazard. Severe where flooding is a hazard.	Fair: moderate frost-action potential; medium or low shear strength.	Unsuited: gravel likely within a depth of 6 feet in major stream valleys.	Good -----	Moderate permeability; water table at a depth of 4 to 5 feet.	Medium or low shear strength and compressibility; susceptibility to piping.	Slopes of 0 to 4 percent; flood hazard in places; water table at a depth of 4 to 5 feet.	Slopes of 0 to 4 percent; susceptibility to piping.
Moderate: 8 to 15 percent slopes; clay loam surface layer.	Poor: low shear strength; soft shale within a depth of 20 inches.	Unsuited ----	Poor: soft shale at a depth of less than 20 inches.	Slopes of 4 to 15 percent; soft shale at a depth of less than 20 inches.	Thin layer; medium compressibility; low shear strength.	Soft shale at a depth of less than 20 inches.	Complex slopes; soft shale within a depth of 20 inches; cuts hard to vegetate.
Moderate if slopes are 8 to 15 percent: small stones. Severe if slopes are 15 to 35 percent.	Poor: low shear strength.	Unsuited ----	Fair or poor if slopes are 8 to 15 percent: 5 to 25 percent small stones. Poor if slopes are 15 to 35 percent.	Moderate permeability; slopes of 2 to 35 percent.	Medium compressibility; low shear strength; susceptibility to piping.	Slopes of 2 to 35 percent; moderate permeability.	Slopes of 2 to 35 percent; susceptibility to piping.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Libeg: LG, LH -----	Slight or moderate: moderate permeability. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: small and large stones. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent; small and large stones. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent: small and large stones; moderate frost-action potential. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 8 to 15 percent; moderate frost-action potential. Severe if slopes are 15 to 60 percent.	Moderate if slopes are 15 to 25 percent: 35 to 50 percent small and large stones on surface. Severe if slopes are 25 to 60 percent: 50 to 75 percent small and large stones on surface.
Linnet: Lk, Lm, Ln -----	Severe: slow permeability.	Severe: clay is hard to dig when dry, and sticky and hard when wet.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; low shear strength.	Severe: high shrink-swell potential; low shear strength.	Severe: clay surface layer.
Lo, Lp -----	Slight: ¹ very rapid permeability below a depth of about 42 inches.	Severe: clay is hard to dig; unstable walls where excavation is into the gravel below a depth of about 42 inches.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; low shear strength.	Severe: high shrink-swell potential; low shear strength.	Severe: clay surface layer.
Litimber: Lr, Ls, Lt, Lu -----	Slight or moderate: moderate permeability.	Moderate: clay loam texture; sticky when wet; hard when dry.	Moderate: low shear strength.	Moderate: moderate frost-action potential; low shear strength.	Severe: medium compressibility; low shear strength.	Slight in Lr, Ls, and Lu. Moderate in Lt: small stones.
*Loberg: LY, LV, LW ----- For Mord part of LV and Whitore part of LW, see their respective series.	Severe: slow permeability; 15 to 45 percent slopes.	Moderate if slopes are 8 to 15 percent: small and large stones. Severe if slopes are 15 to 45 percent.	Moderate if slopes are 8 to 15 percent: small and large stones. Severe if slopes are 15 to 45 percent.	Moderate if slopes are 8 to 15 percent: small and large stones. Severe if slopes are 15 to 45 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 45 percent.	Moderate if slopes are 15 to 25 percent: 30 percent small and large stones. Severe if slopes are 25 to 45 percent.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Moderate if slopes are 8 to 15 percent: 35 to 50 percent small and large stones on surface. Severe if slopes are 25 to 60 percent: 50 to 75 percent small and large stones on surface.	Fair if slopes are 15 to 25 percent: moderate frost-action potential. Poor if slopes are 25 to 60 percent.	Unsuited ----	Poor if slopes are 15 to 60 percent: 35 to 75 percent small and large stones.	Moderate permeability; slopes of 4 to 60 percent.	Medium shear strength; low compressibility; good or fair compaction characteristics.	35 to 75 percent small and large stones; slopes of 4 to 60 percent; moderate permeability.	Slopes of 4 to 60 percent; 35 to 75 percent small and large stones; hard to work or vegetate.
Severe: clay surface layer.	Poor: high shrink-swell potential; low shear strength.	Unsuited ----	Poor: clay texture.	Slow permeability.	Medium compressibility; fair or good compaction characteristics; low shear strength.	Slow permeability; slow intake rate.	Clay is hard to work and vegetate.
Severe: clay surface layer.	Poor: high shrink-swell potential; low shear strength. Good below a depth of 42 inches.	Good for gravel below a depth of 42 inches.	Poor: clay texture.	Slow permeability above a depth of 42 inches; very rapid permeability below a depth of 42 inches.	Medium or high compressibility; fair or good compaction characteristics and low shear strength to a depth of 42 inches; pervious gravel and sand below a depth of 42 inches.	Slow permeability; slow intake rate.	Clay is hard to work and vegetate; gravel exposed in cuts deeper than about 42 inches.
Slight in Lr, Ls, and Lu. Moderate in Lt: small stones.	Poor: low shear strength.	Unsuited ----	Fair in Lr, Ls, and Lu: clay loam. Poor in Lt: cobbly surface layer.	Moderate permeability.	Medium compressibility; low shear strength; low compacted permeability.	Clay loam surface layer in Lr, Ls, and Lu, cobbly clay loam surface in Lt; moderate permeability.	Small stones in Lt.
Moderate if slopes are 8 to 15 percent: 30 percent small and large stones. Severe if slopes are 15 to 45 percent.	Slight if slopes are 4 to 15 percent. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 45 percent.	Poor or unsuited for gravel: 35 to 50 percent fines.	Poor: 30 to 60 percent small and large stones; 15 to 45 percent slopes.	Slopes of 4 to 45 percent.	High or medium shear strength; good to fair compaction characteristics.	Small and large stones in 30 to 60 percent of surface layer; slopes of 4 to 45 percent; slow permeability.	Hard to vegetate; slopes of 4 to 45 percent; 30 to 60 percent small and large stones.

TABLE 7.—Interpretations of engineering

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Martinsdale: Ma, Mb, Mc, Md, Me, Mf, Mg, Mh, Mk, Mm, Mn.	Slight or moderate: moderate permeability. Moderate: 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes; gravelly clay loam or gravelly sandy clay loam.	Moderate: 8 to 15 percent slopes; low shear strength.	Moderate: 8 to 15 percent slopes; moderate frost action potential; low shear strength.	Severe: low shear strength.	Slight if loam surface layer: 0 to 15 percent slopes. Moderate if clay loam surface layer: 0 to 15 percent slopes.
Michelson: Mo, Mp, Mr, Ms, Mt, Mu, Mv, Mw, Mx.	Slight or moderate: moderate permeability. Moderate: 8 to 15 percent slopes.	Moderate or severe: clay loam or gravelly clay loam to a depth of about 38 inches; very gravelly sandy clay loam below; unstable sidewalls.	Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent.	Moderate: 8 to 15 percent slopes; moderate frost-action potential.	Moderate: 8 to 15 percent slopes; moderate frost-action potential.	Slight if 10 to 20 percent small stones on surface. Moderate if 20 to 40 percent small stones on surface.
Mikesell: My -----	Severe: moderately slow permeability; 15 to 35 percent slopes.	Moderate if slopes are 8 to 15 percent: clay loam is sticky when wet; hard to work. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: low shear strength. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential; low shear strength. Severe if slopes are 15 to 35 percent.	Severe: 15 to 35 percent slopes; low shear strength.	Moderate if slopes are 15 to 25 percent: clay loam surface layer. Severe if slopes are 25 to 35 percent.
Mixed alluvial land: MZb. Too variable for interpretation.						
Mord: Mz, MZc -----	Severe: slow permeability; 15 to 35 percent slopes.	Severe: silty clay is sticky when wet; hard to work; 15 to 35 percent slopes.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential; low shear strength. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential; low shear strength. Severe if slopes are 15 to 35 percent.	Severe: 15 to 35 percent slopes; low shear strength.	Slight if slopes are 4 to 15 percent. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 35 percent.
*Nettleton: NB, NM ----- For Burnette part of NB and Mikesell part of NM, see their respective series.	Severe: slow permeability; 15 to 35 percent slopes.	Severe: sticky clay is hard to work when wet; 15 to 35 percent slopes.	Severe: high shrink-swell potential; 15 to 35 percent slopes.	Severe: high shrink-swell potential; 15 to 35 percent slopes.	Severe: 15 to 35 percent slopes; low shear strength.	Moderate if slopes are 15 to 25 percent: clay loam surface layer. Severe if slopes are 25 to 35 percent.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Slight if slopes are 0 to 8 percent: loam surface. Moderate if slopes are 8 to 15 percent: clay loam surface layer.	Poor: low shear strength.	Unsuited ----	Fair or poor: clay loam with 10 to 20 percent small stones.	Moderate permeability; slopes of 0 to 15 percent.	Low shear strength; low or medium compressibility; low compacted permeability; susceptibility to piping.	Slopes of 0 to 15 percent.	Slopes of 0 to 15 percent; susceptibility to piping.
Slight if slopes are 0 to 8 percent: 10 to 20 percent small stones on surface. Moderate if slopes are 8 to 15 percent: 20 to 40 percent small stones.	Fair: moderate frost-action potential.	Unsuited generally, but gravel likely at a depth of 6 feet or less in Mo, Mp, Mt, Mu, and Mx.	Fair or poor: 8 to 15 percent slopes; 10 to 40 percent small stones.	Moderate permeability; slopes of 0 to 15 percent.	Medium or high shear strength; low or medium compressibility; low or medium compacted permeability.	Slopes of 0 to 15 percent; 10 to 40 percent small stones; moderate permeability.	Slopes of 0 to 15 percent.
Moderate if slopes are 8 to 15 percent: clay loam surface layer. Severe if slopes are 15 to 35 percent.	Poor: 25 to 35 percent slopes; low shear strength.	Unsuited ----	Fair if slopes are 8 to 15 percent: clay loam to a depth of 21 inches. Poor if slopes are 15 to 35 percent.	Slopes of 4 to 35 percent.	Low shear strength; medium compressibility; low compacted permeability.	Moderately slow permeability; complex slopes of 4 to 35 percent.	Complex slopes of 4 to 35 percent; cut areas erode easily.
Slight if slopes are 4 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Poor: 25 to 35 percent slopes; low shear strength.	Unsuited ----	Fair or poor: 10 to 25 percent small stones in the surface layer.	Slopes of 4 to 35 percent.	Medium compressibility; low shear strength; low compacted permeability.	Slow permeability.	Deep cuts are hard to vegetate; silty clay texture; slopes of 4 to 35 percent.
Moderate if slopes are 8 to 15 percent: clay loam surface layer. Severe if slopes are 15 to 35 percent.	Poor: 25 to 35 percent slopes; high shrink-swell potential; low shear strength.	Unsuited ----	Fair if slopes are 8 to 15 percent: clay loam texture. Poor if slopes are 15 to 35 percent.	Slopes of 2 to 35 percent.	High or medium compressibility; low shear strength; low compacted permeability.	Slow permeability; slopes of 2 to 35 percent.	Deep cuts into clay are hard to vegetate; slopes of 2 to 35 percent.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Nishon: Nc -----	Severe: surface ponding; slow permeability.	Severe: surface ponding; poorly or somewhat poorly drained; sticky clay hard to work.	Severe: surface ponding; poorly or somewhat poorly drained; high shrink-swell potential.	Severe: surface ponding; poorly drained; high shrink-swell potential.	Severe: surface ponding; poorly drained; high shrink-swell potential.	Severe: surface ponding.
Novary: No -----	Severe: ¹ seasonal water table at a depth of 1 to 2 feet; occasional flooding.	Severe: seasonal water table at a depth of 1 to 2 feet; occasional flooding.	Severe: seasonal water table at a depth of 1 to 2 feet; occasional flooding.	Severe: seasonal water table at a depth of 1 to 2 feet; occasional flooding; high frost action potential.	Severe: poorly drained; high frost-action potential; occasional flooding.	Severe: seasonal water table at a depth of 1 to 2 feet.
Peat: PA. Too variable for interpretation.						
Pendroy: Pc, Pd, Pe, Pf -----	Severe: very slow permeability.	Severe: clay is sticky and hard to work when wet and hard to dig when dry.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; CH material.	Severe: clay surface layer.
*Pishkun: PH ----- For Adel part of PH, see Adel series.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 50 percent.	Severe: very gravelly soil is hard to dig; 15 to 50 percent slopes.	Moderate if slopes are 8 to 15 percent: small stones. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent; small stones; moderate frost action potential. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 50 percent.	Moderate if slopes are 15 to 25 percent: more than 20 percent small stones. Severe if slopes are 25 to 50 percent.
Playas: PL. Too variable for interpretation.						
*Raynesford: RC, RD ----- For Bear Lake part of RC and Hanson part of RD, see their respective series.	Severe: moderately slow permeability; 15 to 20 percent slopes.	Moderate if slopes are 8 to 15 percent: gravelly and cobbly soil hard to work. Severe if slopes are 15 to 20 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 20 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential. Severe if slopes are 15 to 20 percent.	Moderate: 8 to 15 percent slopes; moderate frost-action potential.	Moderate: 15 to 20 percent slopes; 20 to 35 percent small stones on surface.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Severe: surface ponding.	Poor: high shrink-swell potential; high frost-action potential.	Unsuited ----	Poor: clay at a depth of about 7 inches.	Slow permeability.	High or medium compressibility; low compacted permeability; medium or low shear strength.	Surface ponding; poorly or somewhat poorly drained; slow permeability.	Poorly or somewhat poorly drained; clay hard to work and vegetate.
Severe: seasonal water table at a depth of 1 to 2 feet; occasional flooding.	Poor: high frost-action potential; poorly drained.	Unsuited ----	Poor: poorly drained.	Moderate permeability.	Medium compressibility; medium shear strength; medium or low compacted permeability.	Poorly drained.	Poorly drained; poor workability when wet.
Severe: clay surface layer.	Poor: high shrink-swell potential; CH material.	Unsuited ----	Poor: clay soil.	Very slow permeability.	Medium or low shear strength; high compressibility; low compacted permeability.	Very slow permeability.	Clay soil hard to work and vegetate.
Moderate if slopes are 8 to 15 percent; more than 20 percent small stones. Severe if slopes are 15 to 50 percent.	Good if slopes are 8 to 15 percent. Fair if slopes are 15 to 25 percent. Poor if slopes are 25 to 50 percent.	Poor for gravel: 10 to 50 percent fines.	Poor: 15 to 50 percent slopes; more than 20 percent small stones.	Slopes of 8 to 50 percent.	High or medium shear strength; medium or low compacted permeability; low compressibility.	Slopes of 8 to 50 percent; more than 20 percent small stones.	More than 20 percent small stones; hard to vegetate; slopes of 8 to 50 percent.
Moderate if slopes are 8 to 15 percent; 20 to 35 percent small stones on surface. Severe if slopes are 15 to 20 percent.	Fair: 15 to 20 percent slopes; moderate frost-action potential.	Unsuited ----	Poor: 15 to 20 percent slopes; 20 to 35 percent small stones.	Moderately slow permeability; slopes of 2 to 20 percent.	Medium or high shear strength; low compressibility; medium or low susceptibility to piping.	Complex slopes of 2 to 20 percent; moderately slow permeability; 20 to 35 percent small stones.	Complex slopes of 2 to 20 percent; 20 to 35 percent small stones.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Redchief: Re, Rf -----	Severe: slow permeability.	Severe: very gravelly clay material; difficult to work.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate if 25 to 50 percent small stones. Severe if 50 to 70 percent small stones.
*Reeder: Rg, Rh ----- For Arnegard part of Rh, see Arnegard series.	Severe: soft shale at a depth of 30 to 40 inches.	Moderate: soft shale at a depth of 30 to 40 inches.	Moderate: soft shale at a depth of 30 to 40 inches.	Moderate: moderate frost-action potential.	Moderate: moderate frost-action potential; medium or low shear strength.	Slight -----
*Rentsac: RK, Rm, Rn ----- Rock outcrop part of RK too variable for interpretation.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Severe: sandstone at a depth of less than 20 inches; 15 to 60 percent slopes.	Moderate if slopes are 15 to 25 percent; 40 percent large stones on surface. Severe if slopes are 25 to 60 percent.
Rhoades: Ro -----	Severe: very slow permeability.	Moderate: clay loam texture; sticky and hard to work when wet.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; low shear strength.	Moderate: clay loam surface layer.
Riverwash: RS. Too variable for interpretation.						
Rock outcrop: RT. Too variable for interpretation.						
Saline land: SA. Too variable for interpretation.						
*Savage: Sb, Sc, Sd, Se, Sf ----- For Rhoades part of Se and Wayden part of Sf, see their respective series.	Severe: moderately slow permeability.	Moderate: clay loam material; sticky and hard to work when wet.	Moderate: moderate shrink-swell potential; low shear strength.	Moderate: moderate shrink-swell potential; low shear strength.	Severe: low shear strength.	Moderate: clay loam surface layer.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Moderate if 25 to 50 percent small stones. Severe if 50 to 70 percent small stones.	Fair: moderate shrink-swell potential.	Unsuited ----	Poor: 25 to 70 percent small stones.	Slow permeability.	Medium shear strength; low or medium compressibility; low compacted permeability.	Slow permeability; 25 to 70 percent small stones.	25 to 70 percent small stones.
Slight -----	Fair: moderate frost action potential; medium or low shear strength.	Unsuited ----	Fair: silty clay loam below a depth of 6 inches; soft shale at a depth of 30 to 40 inches.	Soft shale at a depth of 30 to 40 inches; moderate permeability.	Medium to low shear strength; medium compressibility; high susceptibility to piping.	Shale at a depth of 30 to 40 inches; moderate permeability.	Shale at a depth of 30 to 40 inches; susceptibility to piping.
Moderate if slopes are 8 to 15 percent: 40 percent large stones on surface. Severe if slopes are 15 to 60 percent.	Poor: sandstone at a depth of less than 20 inches.	Unsuited ----	Poor: more than 40 percent large stones.	Sandstone at a depth of less than 20 inches; slopes of 2 to 60 percent.	Thin layer over sandstone.	Sandstone at a depth of less than 20 inches; slopes of 2 to 60 percent.	Sandstone at a depth of less than 20 inches; slopes of 2 to 60 percent.
Moderate: very slow permeability; clay loam surface layer.	Poor: high shrink-swell potential; low shear strength.	Unsuited ----	Poor: high or moderate alkalinity; clay loam texture.	Very slow permeability.	Low shear strength; medium compressibility; medium or low susceptibility to piping.	High or moderate alkalinity; very slow permeability.	High or moderate alkalinity; susceptibility to piping.
Moderate: clay loam surface layer.	Poor: low shear strength.	Unsuited ----	Fair: clay loam.	Moderately slow permeability.	Low shear strength; medium compressibility; low compacted permeability.	Moderately slow permeability; slow intake.	Moderately slow permeability.

TABLE 7.—Interpretations of engineering

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
<p>*Scobey: Sg, Sh, Sk, Sm, Sn, SO. For Kevin part of Sk, Sm, and Sn and Zahl part of SO, see their respective series.</p>	Severe: moderately slow permeability.	Moderate if slopes are 8 to 15 percent: clay loam material; hard to dig when dry; hard to work when wet and sticky. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential; medium or low shear strength. Severe if slopes are 15 to 35 percent.	Slight if slopes are less than 15 percent: loam surface layer. Moderate if slopes are 15 to 25 percent: clay loam surface layer. Severe if slopes are 25 to 35 percent.
<p>Seeped alluvial land: SP. Too variable for interpretation.</p>						
<p>Sherburne: Sr, SS -----</p>	Severe: slow permeability; 15 to 35 percent slopes.	Severe: gravelly, cobbly, and stony clay hard to dig; 15 to 35 percent slopes.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 15 to 25 percent: 20 to 40 percent small stones on surface. Severe if slopes are 25 to 35 percent.
<p>Stony Land: ST. Too variable for interpretation.</p>						
<p>Sunburst: SU -----</p>	Severe: slow permeability; 15 to 40 percent slopes.	Severe: clay materials; sticky and hard to work where wet and hard to dig where dry; 15 to 40 percent slopes.	Severe: 15 to 40 percent slopes; high shrink-swell potential.	Severe: 15 to 40 percent slopes; high shrink-swell potential.	Severe: 15 to 40 percent slopes; high shrink-swell potential; low shear strength.	Severe: 25 to 40 percent slopes; clay surface layer.
<p>*Swifton: SV, SW, SX ----- For Mikesell part of SV, Mord part of SW, and Garlet part of SX, see their respective series; Rock land part of SW too variable for interpretation.</p>	Moderate if slopes are 8 to 15 percent: moderate permeability. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent: gravelly and cobbly. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action potential; medium or low shear strength. Severe if slopes are 15 to 40 percent.	Moderate if slopes are 8 to 25 percent: 20 to 40 percent small stones on surface. Severe if slopes are 25 to 40 percent.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Slight if slopes are 2 to 8 percent: loam surface layer. Moderate if slopes are 8 to 15 percent: clay loam surface layer. Severe if slopes are 15 to 35 percent.	Fair: medium or low shear strength; moderate shrink-swell potential.	Unsuited ----	Fair if slopes are 8 to 15 percent: clay loam texture. Poor if slopes are 15 to 35 percent.	Moderately slow permeability; slopes of 2 to 35 percent.	Medium or low shear strength; medium compressibility; low compacted permeability.	Moderately slow permeability; slow intake; complex slopes of 2 to 35 percent.	Slopes of 2 to 35 percent.
Moderate if slopes are 8 to 15 percent: 20 to 40 percent small stones on surface. Severe if slopes are 25 to 35 percent.	Fair if slopes are 8 to 15 percent: moderate shrink-swell potential. Poor if slopes are 25 to 35 percent.	Unsuited ----	Poor: 15 to 35 percent slopes; gravelly surface layer.	Slow permeability; slopes of 2 to 35 percent.	Medium shear strength; medium or low compressibility; low compacted permeability.	20 to 40 percent small stones; slow permeability; slopes of 2 to 35 percent.	20 to 40 percent small stones; erodible to a depth of 18 inches; slopes of 2 to 35 percent.
Severe: 15 to 40 percent slopes; clay surface layer.	Poor: 25 to 40 percent slopes; high shrink-swell potential; low shear strength.	Unsuited ----	Poor: 15 to 40 percent slopes; clay texture.	Slopes of 10 to 40 percent.	Low shear strength; medium compressibility; fair or good compaction characteristics.	Clay soils; slopes of 10 to 40 percent; slow permeability.	Slopes of 10 to 40 percent; clay texture.
Moderate if slopes are 8 to 15 percent: 20 to 40 percent small stones on surface. Severe if slopes are 15 to 40 percent.	Fair if slopes are 15 to 25 percent: moderate frost-action potential; medium or low shear strength. Poor if slopes are 25 to 40 percent.	Unsuited ----	Poor: 20 to 40 percent small stones on surface.	Slopes of 8 to 40 percent.	Medium or low shear strength; medium or low compressibility; low compacted permeability.	Slopes of 8 to 40 percent; 20 to 40 percent small stones on surface.	Slopes of 8 to 40 percent; 20 to 40 percent small stones on surface.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Tally: Ta, Tb, Tc, TD -----	Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 20 percent.	Severe: sand below a depth of 42 inches; unstable walls; 15 to 20 percent slopes.	Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 20 percent.	Moderate if slopes are 8 to 15 percent; moderate frost-action potential. Severe if slopes are 15 to 20 percent.	Moderate if slopes are 8 to 15 percent; moderate frost-action potential. Severe if slopes are 15 to 20 percent.	Slight if slopes are 0 to 15 percent. Moderate if slopes are 15 to 20 percent.
*Tanna: Te, Tf, Tg, Th ----- For Absher part of Tg and Wayden part of Th, see their respective series.	Severe: slow permeability; soft shale at a depth of 30 to 40 inches.	Moderate: clay loam material; shale at a depth of 30 to 40 inches; 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes; low shear strength; moderate shrink-swell potential.	Moderate: 8 to 15 percent slopes; low shear strength; moderate shrink-swell potential.	Severe: low shear strength.	Moderate: clay loam surface layer.
Tennex: TK -----	Slight if slopes are 4 to 8 percent. Moderate if slopes are 8 to 15 percent.	Severe: 50 to 70 percent gravel and cobbles below a depth of 23 inches.	Slight if slopes are 4 to 8 percent. Moderate if slopes are 8 to 15 percent.	Moderate: 8 to 15 percent slopes; moderate frost-action potential.	Moderate: 8 to 15 percent slopes; moderate frost-action potential.	Moderate: 25 to 45 percent small stones on surface.
*Terrace escarpments: TL Too variable for interpretation; for Fairfield part, see Fairfield series.						
Thebo: Tm -----	Severe: very slow permeability; soft shale at a depth of 30 to 40 inches.	Severe: sticky clay hard to work when wet or dry.	Severe: high shrink-swell potential; CH material.	Severe: high shrink-swell potential; CH material.	Severe: high shrink-swell potential; CH material.	Severe: clay surface layer.
Timberg: Tn -----	Severe: moderately slow permeability; soft shale at a depth of 30 to 40 inches.	Moderate: soft shale at a depth of 30 to 40 inches.	Moderate: moderate shrink-swell potential; soft shale at a depth of 30 to 40 inches.	Moderate: moderate shrink-swell potential.	Severe: low shear strength.	Moderate: clay loam surface layer.

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Slight if slopes are 0 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 20 percent.	Fair: SM material; 30 to 40 percent fines; moderate frost-action potential. Good below a depth of 42 inches.	Good to poor for sand: 5 to 40 percent fines.	Good if slopes are 0 to 8 percent. Fair if slopes are 8 to 15 percent. Poor if slopes are 15 to 20 percent.	Moderately rapid permeability; slopes of 0 to 20 percent.	Medium shear strength; low to medium compressibility; medium to low compacted permeability; medium to high susceptibility to piping.	Moderately rapid permeability; erodible; slopes of 0 to 20 percent.	Erodible; hard to vegetate; slopes of 0 to 20 percent; susceptibility to piping.
Moderate: 8 to 15 percent slopes; clay loam surface layer.	Poor: low shear strength; soft shale at a depth of less than 40 inches.	Unsuited ----	Fair: clay loam.	Slow permeability; soft shale at a depth of 30 to 40 inches; slopes of 0 to 15 percent.	Low shear strength; medium compressibility; low compacted permeability.	Soft shale at a depth of 30 to 40 inches; slow permeability; slopes of 0 to 15 percent.	Soft shale at a depth of 30 to 40 inches; slopes of 0 to 15 percent.
Moderate: 8 to 15 percent slopes; 25 to 45 percent small stones on surface.	Fair: moderate frost-action potential to a depth of 23 inches. Good below a depth of 23 inches.	Poor for sand or gravel: 15 to 25 percent fines below a depth of 23 inches.	Poor: 25 to 45 percent small stones on surface.	Moderately rapid permeability; slopes of 4 to 15 percent.	Medium or high shear strength; low to medium compressibility; medium to low compacted permeability.	25 to 45 percent small stones on surface; slopes of 4 to 15 percent; low available water capacity; moderately rapid permeability.	25 to 45 percent small stones on surface; hard to vegetate; slopes of 4 to 15 percent.
Severe: clay surface layer.	Poor: high shrink-swell potential; CH material.	Unsuited ----	Poor: clay surface layer.	All features favorable.	Medium or low shear strength; high compressibility; low compacted permeability.	Very slow permeability; soft shale at a depth of 30 to 40 inches.	Clay soil hard to work and vegetate; soft shale at a depth of 30 to 40 inches.
Moderate: clay loam surface layer.	Poor: low shear strength; soft shale at a depth of 30 to 40 inches.	Unsuited ----	Fair to a depth of about 20 inches: clay loam texture.	Moderately slow permeability; slopes of 2 to 8 percent.	Medium or low shear strength; medium compressibility; low compacted permeability.	Shale at a depth of 30 to 40 inches; moderately slow permeability; slopes of 2 to 8 percent.	Shale at a depth of 30 to 40 inches; slopes of 2 to 8 percent.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Tinsley: TN -----	Slight or moderate: ¹ occasional flooding in places.	Severe: very small and large stones; hard to dig; unstable walls.	Slight or severe: severe in areas subject to occasional flooding.	Slight or severe: severe in areas subject to occasional flooding.	Slight or moderate: moderate in areas subject to occasional flooding.	Severe: 40 to 90 percent small and large stones on surface.
*Turner: To, Tr, Ts ----- For Beaverton part of Ts, see Beaverton series.	Slight: ¹ rapid permeability below a depth of 26 inches.	Severe: very small and large stones below a depth of about 40 inches; hard to dig; unstable walls.	Slight -----	Moderate: moderate frost-action potential.	Moderate: moderate frost-action potential; moderate shear strength.	Slight -----
Utica: Ua -----	Slight: ¹ rapid permeability to a depth of 18 inches and very rapid permeability below a depth of 18 inches.	Severe: very small and large stones; unstable walls.	Slight -----	Slight -----	Slight -----	Severe: 45 to 65 percent small and large stones on surface.
Vanda: Va -----	Severe: very slow permeability.	Severe: sticky clay hard to work; hard to dig when dry.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: clay surface layer.
*Wayden: Wa, Wb, Wc, WD -- For Absher part of Wc, see Absher series; Shale outcrop part of WD too variable for interpretation.	Severe: slow permeability; soft shale at a depth of less than 20 inches.	Moderate: soft shale at a depth of less than 20 inches. Severe: 15 to 50 percent slopes.	Moderate: soft shale at a depth of less than 20 inches. Severe: 15 to 50 percent slopes.	Moderate or severe if slopes are 8 to 15 percent: moderate or high shrink-swell potential. Severe if slopes are 15 to 50 percent.	Moderate or severe: low to moderate shear strength. Severe: 15 to 50 percent slopes.	Moderate: clay loam surface layer. Severe: 25 to 50 percent slopes.
Wet alluvial land: WE. Too variable for interpretation.						

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Severe: 40 to 90 percent small and large stones on surface.	Good -----	Good for gravel or sand.	Poor: 40 to 90 percent small and large stones.	Rapid permeability.	High shear strength; low or medium susceptibility to piping; high compacted permeability.	40 to 90 percent small and large stones; very low available water capacity.	40 to 90 percent small and large stones; droughty; rapid permeability.
Slight -----	Good below a depth of 26 inches. Fair above a depth of 26 inches: moderate shear strength.	Unsuited to gravel or sand above a depth of 26 inches. Fair for gravel or sand below a depth of 26 inches: 5 to 15 percent fines. Good for gravel below a depth of 60 inches.	Fair or poor: 0 to 20 percent small and large stones in upper 20 inches.	Moderate permeability; very rapid permeability below a depth of 40 inches.	Medium shear strength; low or medium compressibility; low or high compacted permeability.	Low available water capacity; moderate permeability above a depth of 40 inches; very rapid permeability below a depth of 40 inches.	Very gravelly at a depth of 30 to 40 inches; very rapid permeability below a depth of 40 inches.
Severe: 45 to 65 percent small and large stones on surface.	Good -----	Good to poor for gravel above a depth of 18 inches: 10 to 15 percent fines. Good below a depth of 18 inches.	Poor: 45 to 65 percent small and large stones.	Rapid permeability.	High compacted permeability; high shear strength; low compressibility.	45 to 65 percent small and large stones; very low available water capacity; rapid permeability.	Droughty; hard to work; rapid permeability; very gravelly to a depth of 18 inches.
Severe: clay surface layer.	Poor: high shrink-swell potential.	Unsuited ----	Poor: strongly alkaline; clay texture.	All features favorable.	Medium or high compressibility; medium to low shear strength; low compacted permeability.	Very slow intake rate; strongly alkaline; very slow permeability.	Strongly alkaline; clay soil difficult to vegetate.
Moderate: clay loam surface layer. Severe: 15 to 50 percent slopes.	Poor: shale at a depth of less than 20 inches; moderate shear strength.	Unsuited ----	Poor: soft shale at a depth of less than 20 inches.	Slopes of 4 to 50 percent; soft shale at a depth of less than 20 inches.	Medium or low shear strength; medium compressibility; low compacted permeability.	Soft shale at a depth of less than 20 inches; slow permeability; slopes of 2 to 50 percent.	Shale at a depth of less than 20 inches; slopes of 2 to 50 percent.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow excavations	Dwellings		Local roads and streets	Paths and trails
			With basements	Without basements		
Wet land: WF. Too variable for interpretation.						
Whitore: WG, WH, WL -----	Slight if slopes are 2 to 8 percent: moderate permeability. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 60 percent.	Moderate: 25 to 65 percent small and large stones. Severe: 15 to 60 percent slopes.	Slight if slopes are 2 to 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 60 percent.	Moderate: moderate frost-action potential. Severe: 15 to 60 percent slopes.	Moderate: moderate frost-action potential. Severe: 15 to 60 percent slopes.	Moderate: 25 to 40 percent small and large stones on surface. Severe: 15 to 60 percent slopes.
*Williams: Wk, Wm, WN, WO, Wr, WS, WT. For Zahl part of Wr, WS, and WT, see Zahl series.	Severe: moderately slow permeability.	Moderate: clay loam hard to work. Severe: 15 to 35 percent slopes.	Moderate: moderate shrink-swell potential; moderate frost-action potential. Severe: 15 to 35 percent slopes.	Moderate: moderate shrink-swell potential; moderate frost-action potential. Severe: 15 to 35 percent slopes.	Moderate: moderate shrink-swell and frost-action potential. Severe: 15 to 35 percent slopes.	Slight if slopes are less than 15 percent. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 35 percent.
Yetull: Ye -----	Slight: ¹ rapid permeability.	Severe: sand texture; unstable walls.	Slight -----	Slight -----	Slight -----	Severe: loose fine sand.
*Zahl: ZA ----- For Kevin part, see Kevin series.	Severe: moderately slow permeability.	Moderate if slopes are 8 to 15 percent: clay loam or cobbly loam texture. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action and shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate if slopes are 8 to 15 percent: moderate frost-action and shrink-swell potential. Severe if slopes are 15 to 35 percent.	Moderate: moderate frost-action and shrink-swell potential. Severe: 15 to 35 percent slopes.	Slight if slopes are less than 15 percent: loam surface layer. Moderate if slopes are 15 to 25 percent. Severe if slopes are 25 to 35 percent.

¹ Hazard of ground water pollution in places.

mately parallel to the terms slight, moderate, and severe.

Following are explanations of the columns in table 7. Additional information is given in "Guide for Interpreting Engineering Uses of Soils" (12). Interpretations for uses not listed in table 7 can be derived

from the estimated properties of soils in table 6 and the soil descriptions in the section "Descriptions of the Soils."

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material be-

properties of the soils—Continued

Degree and kind of limitation for—Continued	Suitability as a source of—			Soil features affecting—			
	Picnic areas and camp areas	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Moderate: 25 to 40 percent small and large stones on surface. Severe: 15 to 60 percent slopes.	Fair: moderate frost-action potential. Poor: 25 to 60 percent slopes.	Poor for gravel: 35 to 45 percent fines; large stones.	Poor: 25 to 40 percent small and large stones on surface.	Moderate permeability; slopes of 2 to 60 percent; 25 to 65 percent small and large stones.	Medium or high shear strength; low or medium compressibility; low compacted permeability.	25 to 40 percent small and large stones on surface; slopes of 2 to 60 percent.	Slopes of 2 to 60 percent; hard to work and vegetate; 25 to 65 percent small and large stones.
Slight if slopes are less than 8 percent. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Fair: moderate shrink-swell and frost-action potential. Poor: 25 to 35 percent slopes.	Unsuited ----	Fair if 10 to 25 percent small and large stones. Poor if 15 to 35 percent slopes.	Moderately slow permeability; slopes of 2 to 35 percent.	Medium or low shear strength; medium compressibility; low compacted permeability.	Complex slopes of 2 to 35 percent; moderately slow permeability.	Complex slopes of 2 to 35 percent.
Severe: loose fine sand.	Good -----	Good or fair for sand: less than 5 to 10 percent fines.	Poor: fine sand.	Rapid permeability; slopes of 2 to 8 percent.	Medium to high compacted permeability; medium shear strength; low compressibility.	Low available water capacity; erodible.	Highly erodible; hard to vegetate.
Slight if slopes are less than 8 percent: loam surface layer. Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 35 percent.	Fair: moderate frost-action and shrink-swell potential. Poor: 15 to 35 percent slopes.	Unsuited ----	Fair if slopes are less than 15 percent: 10 to 35 percent small stones. Poor if slopes are 15 to 35 percent.	Slopes of 2 to 35 percent; moderately slow permeability.	Medium compressibility; medium to low shear strength; low compacted permeability; slopes of 2 to 35 percent.	Complex slopes of 2 to 35 percent; 0 to 10 percent small and large stones in surface layer in some areas; moderately slow permeability.	Complex slopes of 2 to 35 percent; 0 to 10 percent small and large stones in surface layer in some areas.

tween depths of 24 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects difficulty of layout

and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavation for pipelines, sewerlines, tele-

TABLE 8.—*Engineering*
[Tests performed by the Montana State Highway

Soil name and location	Helena laboratory No.	Depth	Classification		Mechanical analysis ¹		
					Percentage passing sieve—		
			Unified ^a	AASHTO ^a	3 in	1½ in	¾ in
		<i>In</i>					
Loberg stony loam: 200 feet W. and 1,900 feet N. of SE. corner sec. 15, T. 34 N., R. 14 E.	356061	6-15	ML	A-6 (7)	100	100	95
	356062	28-53	GC	A-4 (0)	100	91	78
	356063	53-69	GC-GM	A-2-4 (0)	100	89	75
Martinsdale gravelly clay loam: 50 feet W. and 25 feet N. of SE. corner sec. 36, T. 33 N., R. 7 W.	356068	6-15	CL	A-6 (7)	100	99	96
	356069	24-38	CL	A-6 (5)	100	100	94
	356070	58-68	SC	A-2-6 (0)	100	97	88
	356071	68-90	GP	A-1-a (0)	100	67	49
Michelson cobbly loam: 500 feet N. and 1,600 feet W. of center sec. 2, T. 34 N., R. 12 W.	356064	5-13	SC-SM	A-6 (3)	100	100	99
	356065	18-34	CL	A-6 (3)	100	100	99
	356066	48-72	GC	A-2-6 (0)	100	78	58
	356067	72-108	GW-GM	A-1-a (0)	100	76	64
Scobey clay loam: 1,400 feet E. and 150 feet N. of SW. corner sec. 36, T. 32 N., R. 6 W.	317850	0-5	ML	A-4 (7)	100	100	99
	317851	11-20	ML	A-4 (7)	100	100	99.7
	317852	37-49	ML	A-4 (6)	100	96.2	94.9
	317853	49-79	CL	A-4 (8)	100	100	99.5

¹ Mechanical analysis according to the AASHTO Designation T 88-57 (2). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data in this table are not suitable for naming textural classes of soils.

phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops and of stones and boulders, and freedom from flooding and from a high water table.

Dwellings, as rated in table 7, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings relate to capacity to support load and resist settlement under load and to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, frost action potential and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones. Ratings are given for dwellings with basements and without basements. Ratings for dwellings with basements are based on footings placed below the frostline.

Local roads and streets, as rated in table 7, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly of asphalt or concrete. These

roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. Soil properties that most affect design and construction of roads and streets are the load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, the frost-action potential, and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Paths and trails are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks on the surface.

Picnic areas are attractive natural or landscaped tracts used mainly for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to

test data

Commission Testing Laboratory, Helena, Montana]

Mechanical analysis ¹ —continued						Liquid limit	Plasticity index	Moisture density ²		Activity index
Percentage passing sieve—continued				Percentage smaller than—				Maximum dry density	Optimum moisture content	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.005 mm	0.002 mm					
						<i>Pct</i>		<i>Lb per cu ft</i>	<i>Pct</i>	
91	84	77	70	16	8	37	11	98.78	21.53	1.10
64	58	53	36	15	11	28	9	120.70	13.21	.54
61	56	49	35	15	11	21	7	130.20	9.70	.41
94	92	88	59	31	22	39	16	100.60	21.00	.73
89	87	82	54	35	26	25	12	120.40	12.95	.34
74	71	66	32	20	16	25	11	111.31	16.16	.50
24	18	8.5	1.4	0.7	0.5	^a NP	^a NP			
98	96	91	49	26	18	34	11	105.10	18.50	.60
98	95	89	51	32	25	30	11	106.42	18.70	.45
39	30	20	11	7	6	23	11	127.50	10.60	.59
39	29	22	6.6	3	2	^a NP	^a NP	130.74	10.37	
98	97	94	72	30	19	31	3.72	99.15	22.54	
98.8	98	95	71	35	28	29.5	6.25	104.68	19.40	
92.8	91	87	67	38	29	29	6.13	112.95	16.30	
96.2	94	89	77	36	27	27	8.32	112.02	17.10	

¹ By Harvard Compaction Apparatus (3).

² Based on the Unified soil classification system (13).

³ Based on AASHTO Designation M 145-49 (2).

^a NP means nonplastic.

access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increase costs of leveling sites or building access roads.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have gentle slopes, good drainage, a surface free of rock fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for probable sources. A soil rated as *good* or *fair* generally has a layer of sand or gravel at least 3 feet thick, the top of which is at a depth of less than 6 feet. The ratings

do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, nor do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil is unfavorable.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion,

or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer; amount of water held available to plants; and need for drainage or depth to water table or bedrock.

Terraces, diversions, and waterways are used to carry runoff. Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet or waterway. Features that affect suitability of a soil for terraces, diversions, and waterways are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Engineering test data

Table 8 contains engineering test data for some of the major soil series in the area. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Moisture-density (or compaction) data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Activity index is the ratio of the plasticity index to the percentage of soil smaller than 0.002 millimeter. It is used as a qualitative means of identifying clay minerals that shrink or swell when used within or as foundation for an engineering structure. In table 8 any soil that has an activity index greater than 0.5 is considered active and is suspect of swelling or shrinking properties, or both.

Formation and Classification of the Soils

This section tells how the factors of soil formation

have affected the development of soils in the survey area. It also explains the system of soil classification currently used and classifies each soil series in the area according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the parent material to change into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The parent material is largely responsible for the initial chemical and mineralogical composition of a soil and thus for many of the physical properties. The parent materials in the survey area are derived from various sources. Many of the parent materials weathered from various rock formations outside the area. They were then transported by streams and glaciers into the survey area and formed a mantle of unconsolidated material over the local bedrock formations. Part of the area was not mantled, or the mantle was removed by natural erosion processes. In this part the soils formed in material weathered in place from local shale and sandstone bedrock.

Cabba, Thebo, and Rentsac soils formed in material weathered from the local bedrock. These soils have characteristics inherited from siltstone and shale, clay shale, and sandstone, respectively. In the central part of the survey area there is a small area of red shale, which is reflected in the reddish Kuro and Timberg soils.

A large part of the transported parent material is from mixed rock sources, and as a result the soils that formed in these materials have a blend of parent material characteristics. Scobey, Williams, and Leavitt soils formed in mixed loamy material. Raynesford soils, however, formed in highly calcareous material that was transported by a valley glacier which originated in a limestone area. Pendroy and Linnet soils

formed in clay material that was sorted by water from the mixed glacial till and deposited in broad basins and outwash plains. This water sorting also left the silt and sand in which the Ethridge and Attewan soils formed.

Climate

Climate is an active force in soil formation. In this survey area climatic variations are responsible mainly for a number of different soils. Climate affects the formation of soils through its influence on the rate of weathering of rocks and on the decomposition of minerals and organic matter. It also affects biological activity in the soil and the leaching and movement of weathered minerals.

The eastern part of the survey area has a relatively dry, cool climate. Soluble material, such as calcium carbonate, remains at a shallow depth, and plant nutrients are not leached from the soil. Although vegetation is not abundant, plant remains do not readily decay and organic matter accumulates in the surface layer. The physical weathering forces of wetting and drying and freezing and thawing are active in this part. Westward toward the mountains, the precipitation increases, summer soil temperatures become cooler, and winter snow is heavier than in the eastern part of the Area. Changes in soil features and in vegetation follow the changes in climate. The sequence of Scobey, Williams, and Leavitt soils, all of which formed in loamy glacial till, illustrates these changes.

Relief

Relief influences soil formation through its effect on runoff, erosion, supplemental moisture accumulation, plant cover, and soil temperature.

The length, shape, steepness, and exposure of slopes hasten or slow the rate of runoff and erosion. For example, Adel soils are mainly in concave areas where they receive moisture from the slopes above. They have a very thick surface layer and have been leached of lime by deep percolation, in contrast to the adjacent Babb soil. Such steep soils as the Pishkun soils have rapid runoff and erosion even though the soil is quite porous. The south-facing slopes are drier than the north-facing slopes because they are exposed to the drying sun and to the prevailing wind.

The effects of changes in relief on soil formation can usually be observed in the soil profile. The differences may, however, not be great enough to cause differences in use and management.

Plants and animals

Plants, animals, bacteria, and other organisms are active agents in soil formation. The kinds of plants and animals that live in and on the soil are affected by the parent material, climate, relief, and age of the soil.

Most of the soils in this survey area formed under grass, but some of them formed under forest. Plants supply most of the organic matter to the soil.

Grass has a fibrous root system, and where the climate allows abundant growth the organic-matter content of the soil is high. Leavitt, Babb, and Adel soils all have high organic-matter content and, therefore, have a black surface layer.

In the forests, needles, leaves, twigs, or entire plants accumulate on the surface and are decomposed by micro-organisms and other forms of life. Water percolating through this organic layer removes organic acids that bleach the mineral surface layer, as illustrated by the gray surface layer of Loberg soils.

Small animals, earthworms, insects, and micro-organisms also influence the formation of soils by mixing organic matter into the soil, by decomposing plant remains, and by burrowing and mixing soil layers. Some areas of the Fairfield soils on the plains have been intensely worked by ground squirrels and badgers.

Time

Generally, a relatively long time is required for a soil to form. Parent material of a given character is influenced by the existing climatic conditions, by the landscape position, and by plants and animals, but time is needed for change and formation. Changes in soils involve hundreds or thousands of years.

Climate has changed in the past and some soil morphologic characteristics may be those of relict soils. The IIB2bca horizon in the Michelson soils is thought to be a part of the relict soil that formed under a past environment. The secondary calcium carbonate, designated by *ca*, represents a cycle of soil genesis related to the present environment and accumulated after burial of the relict soil.

The effects of time are most easily seen in recently deposited alluvium as evidenced by each year's deposit of overflow silt and sand. On a somewhat higher surface, similar deposits a few years old are matted with roots and plant residue, and soil development has commenced. The Korchea and Kiwanis soils of this survey area are mostly above the present flood plain and have been in place long enough for the surface layer to have been darkened by accumulating organic matter. Kiev soils on the adjacent higher terraces have distinct horizons. Lime has been leached from the upper part of the soil and is deposited in a definite zone below, and the subsoil has developed structure.

The profile expresses the total effect of the soil-forming factors over time. For example, the time needed for accumulation of organic matter to form an A horizon is considerably less than that needed for translocation of clay to form a clay film.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The system for classifying soils currently used by the National Cooperative Soil Survey was developed in the early sixties (8) and was adopted in 1965 (11). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 9 shows the classification of each soil series in the survey area by family, subgroup, and order, according to the classification system. The classes of this system are defined in the following paragraphs.

ORDER: Ten soil orders are recognized as classes in the system. The differentiae for the orders are based on the kind and degree of the sets of soil forming processes dominant for the various soils. Each order is named with a word of three or four syllables ending in *sol*. An example is Inceptisol.

SUBORDER: Each order is divided into suborders based primarily on properties that influence soil genesis and that are important to plant growth, or selected to reflect what seemed to be the most important variables within the orders. The names of suborders have exactly two syllables. The last syllable indicates the order. An example is Ochrept (*ochr*, meaning pale, and *ept* from Inceptisol).

GREAT GROUP: Soil suborders are separated into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons, in soil moisture and temperature regimes, and in base status. The names of great groups have three or four syllables and end with the name of a suborder. A prefix added to the name suggests something about the properties of the soil. An example is Cryochrept (*cry*, meaning cold, and *ochrept*).

SUBGROUPS: Great groups are divided into three kinds of subgroups: The central (typic) concept of the great groups (not necessarily the most extensive subgroup); the intergrades, transitional forms to other orders, suborders, or great groups; and extragrade subgroups, which have some properties that are representative of the great groups but that 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 Cryochrept (a typical Cryochrept).

FAMILY: Soil families group soils within a subgroup that have similar enough physical and chemical properties that responses to management and manipulation for use are nearly the same for comparable phases. Among the properties considered in horizons of major biological activity below plow depth, are particle-size distribution, mineralogy, 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 particle size, mineralogy, reaction, and so on, that are used as family differentiae. An example in table 9 is the loamy-skeletal, carbonatic family of Typic Cryochrepts.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and have horizons that, except for texture of the surface layer, 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. The names are place names taken from the area where the soil was first defined. An example is the Whitore series, which is in the loamy-skeletal, carbonatic family of Typic Cryochrepts.

Climate⁴

In most ways the survey area has a continental climate. It has cold, relatively dry winters, fairly warm summers, and a pronounced wet season in May and June. However, there are exceptions, mainly because of topography. The most important exception is the very heavy winter snowfall along the western border. Annual snowfall ranges from about 205 inches at East Glacier Park to about 39 inches at Cut Bank. The precipitation shadow that covers most lower elevations in the area is particularly noticeable in winter. It is caused by the effect of the Continental Divide on the prevailing southwest to west airflow from the North Pacific Ocean. Another exception is the foehn, or chinook, winds, which are often quite strong and occur several times a year but have their most dramatic effect in winter. In winter, cold periods generally end with a chinook in which temperatures rise from below zero to between 20 and 40 degrees. Wind velocity over much of the area reaches 30 miles per hour or more. The frequency of these winds is the main basis for concluding that the prevailing wind for nearly all of the area is westerly. Only slight local variations in wind direction are caused by topographic features.

Winter generally is rather cold, but there are some comparatively warm periods. Mean January temperature, 17° F at Cut Bank and 18° F at Babb and Browning, is rather moderate for this latitude under a continental climatic regime. Winter is affected by the warm chinooks as well as by the invasions of cold air from the Arctic. The cold spells, however, seldom last more than 2 or 3 days before a chinook develops. The lowest temperature ever observed in the survey area was -56° at Browning, and generally, the coldest temperature in winter is about -30° to -40°. Subzero lows may be expected on about 30 mornings during an average winter.

Summer is warm and comfortable in most years and lacks oppressive heat. Highs of 90° or more are observed on 7 days or less a year, and 100° occurs only rarely in a few low elevations in the southeastern corner of the survey area. Facts about temperature and precipitation are given in table 10. Table 11 gives for various locations the probability of the occurrence of temperatures of 32° or colder in spring and fall for specified dates. Table 12 shows that the growing season is quite short at Babb and Browning in the western half of the area, but it is 40 to 50 days longer in the

⁴R. A. DIGHTMAN, climatologist for Montana, National Weather Service, U.S. Department of Commerce, helped to prepare this section.

TABLE 9.—Soil series classified

Series	Family	Subgroup	Order
Absher	Fine, montmorillonitic	Borollic Natrargids	Aridisols.
Adel	Fine-loamy, mixed	Pachic Cryoborolls	Mollisols.
Arnegard	Fine-loamy, mixed	Pachic Haploborolls	Mollisols.
Attewan	Fine-loamy over sandy or sandy skeletal, mixed.	Aridic Argiborolls	Mollisols.
Babb	Fine-loamy, mixed	Typic Cryoborolls	Mollisols.
Babb variant	Coarse-loamy, mixed	Typic Cryoborolls	Mollisols.
Bear Lake ¹	Fine-silty, frigid	Typic Calciaquolls	Mollisols.
Bearmouth	Sandy-skeletal, mixed	Typic Cryoborolls	Mollisols.
Beaverton	Loamy-skeletal, mixed	Typic Argiborolls	Mollisols.
Boxwell	Fine-loamy, mixed	Aridic Haploborolls	Mollisols.
Bridger	Fine, mixed	Argic Cryoborolls	Mollisols.
Brockway	Fine-silty, mixed	Borollic Calciorrhiths	Aridisols.
Burnette	Fine, montmorillonitic	Argic Pachic Cryoborolls	Mollisols.
Bynum	Fine-loamy, mixed	Typic Cryoborolls	Mollisols.
Cabba	Loamy, mixed (calcareous), frigid, shallow	Typic Ustorthents	Entisols.
Castner	Loamy-skeletal, mixed	Lithic Haploborolls	Mollisols.
Cheadle	Loamy-skeletal, mixed	Lithic Cryoborolls	Mollisols.
Crago	Loamy-skeletal, carbonatic	Borollic Calciorrhiths	Aridisols.
Dimmick	Fine, montmorillonitic, frigid, mixed	Vertic Haplaquolls	Mollisols.
Doby	Clayey, montmorillonitic, shallow	Typic Cryoborolls	Mollisols.
Ethridge	Fine, montmorillonitic	Aridic Argiborolls	Mollisols.
Fairfield	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Farnuf	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Fifer	Loamy, mixed, shallow	Typic Cryoborolls	Mollisols.
Gallatin	Fine-loamy, mixed	Pachic Cryoborolls	Mollisols.
Gapo	Fine, montmorillonitic (calcareous)	Typic Cryaquolls	Mollisols.
Garlet	Loamy-skeletal, mixed	Typic Cryochrepts	Inceptisols.
Hanson	Loamy-skeletal, carbonatic	Calcic Cryoborolls	Mollisols.
Kevin	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Kiev	Fine-loamy, mixed	Typic Calciborolls	Mollisols.
Kiwanis	Coarse-loamy over sandy or sandy-skeletal, mixed (calcareous), frigid.	Typic Ustifluvents	Entisols.
Korchea	Fine-loamy, mixed (calcareous), frigid	Typic Ustifluvents	Entisols.
Kuro	Clayey, mixed (calcareous), frigid, shallow	Typic Ustorthents	Entisols.
Leavitt	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Libeg	Loamy-skeletal, mixed	Argic Cryoborolls	Mollisols.
Linnet	Fine, montmorillonitic	Ustertic Argiborolls	Mollisols.
Litimber	Fine, mixed	Typic Haploborolls	Mollisols.
Loberg	Clayey-skeletal, mixed	Typic Cryoborolls	Alfisols.
Martinsdale	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Michelson	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Mikesell	Fine, montmorillonitic	Typic Cryoborolls	Alfisols.
Mord	Fine, montmorillonitic	Boralfic Cryoborolls	Mollisols.
Nettleton ²	Fine, montmorillonitic, frigid	Argiaquic Xeric Argialbolls	Mollisols.
Nishon	Fine, montmorillonitic, frigid	Typic Albaqualls	Alfisols.
Novary	Fine-loamy, mixed (calcareous)	Cumulic Cryaquolls	Mollisols.
Pendroy	Very fine, montmorillonitic (calcareous), frigid.	Ustertic Torriorthents	Entisols.
Pishkun	Loamy-skeletal, mixed (calcareous)	Typic Cryorthents	Entisols.
Raynesford	Fine-loamy, carbonatic	Calcic Cryoborolls	Mollisols.
Redchief	Clayey-skeletal, montmorillonitic	Argic Cryoborolls	Mollisols.
Reeder	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Rentsac	Loamy-skeletal, mixed (calcareous), frigid	Lithic Ustic Torriorthents	Entisols.
Rhoades	Fine, montmorillonitic	Leptic Natriborolls	Mollisols.
Savage	Fine, montmorillonitic	Typic Argiborolls	Mollisols.
Scobey	Fine, montmorillonitic	Aridic Argiborolls	Mollisols.
Sherburne	Clayey-skeletal, mixed	Boralfic Cryorthods	Spodosols.
Sunburst	Fine, montmorillonitic (calcareous), frigid	Ustic Torriorthents	Entisols.
Swifton	Fine-loamy, mixed	Typic Cryoborolls	Alfisols.
Tally	Coarse-loamy, mixed	Typic Haploborolls	Mollisols.
Tanna	Fine, montmorillonitic	Aridic Argiborolls	Mollisols.
Tenex	Loamy-skeletal, mixed	Typic Cryorthods	Spodosols.
Thebo	Very fine, montmorillonitic (calcareous), frigid.	Ustertic Torriorthents	Entisols.
Timberg	Fine, mixed	Typic Haploborolls	Mollisols.
Tinsley	Sandy-skeletal, mixed, frigid	Typic Ustorthents	Entisols.
Turner	Fine-loamy over sandy or sandy-skeletal, mixed.	Typic Argiborolls	Mollisols.
Utica	Sandy-skeletal, carbonatic	Typic Calciborolls	Mollisols.
Vanda	Fine, montmorillonitic (calcareous), frigid	Ustic Torriorthents	Entisols.
Wayden	Clayey, montmorillonitic (calcareous), frigid, shallow.	Typic Ustorthents	Entisols.

TABLE 9.—*Soil series classified*—Continued

Series	Family	Subgroup	Order
Whitore -----	Loamy-skeletal, carbonatic -----	Typic Cryochrepts -----	Inceptisols.
Williams -----	Fine-loamy, mixed -----	Typic Argiborolls -----	Mollisols.
Yetull -----	Mixed, frigid -----	Ustic Torripsammets -----	Entisols.
Zahl -----	Fine-loamy, mixed -----	Entic Haploborolls -----	Mollisols.

¹ The Bear Lake soils in the survey area are taxadjunct to the Bear Lake series because the soil temperature is a few degrees lower than is defined as within the range for the Bear Lake series.

² The Nettleton soils are taxadjunct to the Nettleton series because they lack an A2 horizon and are somewhat better drained than is defined as within the range of the Nettleton series.

eastern part around Cut Bank, where the average 32° growing season is 108 days, May 27 to September 12.

On most of the arable land in the survey area, about three-fourths of the annual precipitation falls from April to September and more than half during May, June, and July. The western mountains are comparatively moist all year.

The long hours of sunshine during midsummer help to produce rapid growth during the relatively short growing season. The possible sunshine on June 20 is more than 16 hours over the whole survey area. This potential lasts from early June to mid-July and partly explains the rapid growth of vegetation during the frost-free season. Summer mornings generally are clear, but on 30 to 40 days each season there is afternoon cloudiness associated with thunderstorms. Thunderstorms in most seasons will produce enough hail to cause some crop damage in the eastern half of the area. Damage to crops, however, is seldom widespread.

The most troublesome common storm is the high wind that is often associated with the chinook. Gusts of 100 miles per hour have been noted at the Cut Bank Airport. Blizzard conditions sometimes accompany an invasion of cold arctic air, but this seldom lasts more than a few hours. Relative humidity generally is low during a chinook and under such conditions topsoil dries rapidly, so the hazard of erosion on cultivated fields is high. Evapotranspiration under these conditions can be high for a few days. Growing-season precipitation almost equals evapotranspiration losses during the frost-free period in the eastern half of the Area. Precipitation almost always exceeds evapotranspiration losses in the western half.

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Glossary

- Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.
- Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.
- Available water capacity** (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.
- Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.
- 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.
- Claypan.** A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.
- Colluvium.** Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.
- 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

TABLE 10.—Temperature and precipitation data

CUT BANK									
Month	Temperature			Precipitation					
	Average daily—		Average	Snowfall	Average total	1 year in 10 will have—		3 years in 10 will have—	
	High	Low				Less than—	More than—	Less than—	More than—
	°F	°F	°F	In	In	In	In	In	In
January	28	7	18	6	0.4	0.1	0.7	0.1	0.4
February	31	9	20	6	.4	.1	.8	.2	.5
March	38	17	28	6	.5	.1	1.0	.3	.6
April	53	28	41	5	.8	.1	1.8	.5	1.0
May	63	38	51	2	1.8	.5	3.7	1.1	2.4
June	69	45	57	(¹)	2.9	1.0	6.1	1.7	3.5
July	80	50	65	(¹)	1.3	.2	2.8	.5	1.7
August	78	48	63	(¹)	1.2	.2	3.5	.4	1.4
September	67	40	54	2	1.1	.2	2.3	.5	1.5
October	57	32	45	4	.5	.1	1.2	.2	.7
November	41	20	31	5	.3	.1	.9	.1	.4
December	34	13	24	5	.3	.1	.7	.1	.4
Year	53	29	41	41	11.5	8.2	16.1	9.5	12.9

BROWNING									
Month	High	Low	Average	Snowfall	Average total	Less than—	More than—	Less than—	More than—
	°F	°F	°F	In	In	In	In	In	In
January	29	9	19	11	.8	.1	1.8	.4	1.1
February	32	12	22	11	.8	.1	1.8	.5	1.1
March	38	17	28	11	.8	.2	1.5	.5	.9
April	51	28	40	8	1.1	.3	2.0	.5	1.5
May	62	36	49	2	1.9	.4	3.4	1.1	2.2
June	68	42	55	(¹)	3.3	.5	6.5	2.0	4.0
July	78	45	63	(¹)	1.4	.1	3.2	.5	2.3
August	76	45	62	(¹)	1.1	.2	2.3	.5	1.6
September	67	39	53	2	1.4	.3	2.4	.6	1.8
October	56	32	44	5	1.0	.2	2.4	.4	1.1
November	41	21	31	6	.8	.1	2.0	.4	.9
December	35	16	26	10	.7	.1	1.6	.4	.9
Year	53	29	41	66	15.1	10.0	19.2	13.1	16.3

BABB									
Month	High	Low	Average	Snowfall	Average total	Less than—	More than—	Less than—	More than—
	°F	°F	°F	In	In	In	In	In	In
January	31	7	19	15	.8	.1	2.2	.4	.9
February	33	9	21	15	.9	.1	1.8	.7	1.2
March	39	15	27	15	1.0	.4	1.9	.6	1.2
April	51	26	39	12	1.5	.4	2.8	.7	1.7
May	61	34	48	3	2.6	.9	5.5	1.5	3.5
June	66	40	53	(¹)	4.2	1.2	7.6	2.6	5.5
July	76	44	60	(¹)	1.6	.2	4.1	.6	2.1
August	75	42	59	(¹)	1.6	.3	3.5	.6	1.9
September	66	36	51	4	2.1	.8	3.6	1.3	2.8
October	56	30	43	11	1.2	.2	2.9	.5	1.6
November	43	20	32	10	.9	.2	1.4	.4	1.0
December	37	14	26	13	.9	.1	1.6	.3	1.0
Year	53	26	40	98	19.3	14.0	25.3	16.4	21.2

SUMMIT ²					EAST GLACIER PARK ³				
Month	High	Low	Average	Snowfall	Average total	Less than—	More than—	Less than—	More than—
	°F	°F	°F	In	In	In	In	In	In
January	24	7	15	33	4.0				
February	27	9	18	39	3.2				
March	34	14	24	31	2.7				
April	45	23	39	25	2.7				
May	56	31	44	5	2.6				
June	62	37	50	2	3.1				
July	74	40	57	(¹)	1.7				
August	72	38	55	(¹)	1.2				
September	62	34	48	3	2.2				
October	49	29	39	11	2.2				
November	33	18	26	31	3.7				
December	28	14	21	27	2.8				
Year	47	25	36	207	32.0				

¹ Trace.

² No precipitation given for Summit station.

³ No temperature data given for East Glacier Park station.

TABLE 11.—Probability of last freezing temperature in spring and first in fall

CUT BANK			
Probability	Dates for given probability and temperature		
	24° or lower	28° or lower	32° or lower
Spring:			
9 years in 10 later than ---	April 12	April 28	May 12
5 years in 10 later than ---	April 27	May 13	May 27
1 year in 10 later than ---	May 12	May 28	June 11
Fall:			
9 years in 10 earlier than --	October 17	October 5	September 27
5 years in 10 earlier than --	October 2	September 20	September 12
1 year in 10 earlier than --	September 16	September 4	August 27

BROWNING			
Probability	Dates for given probability and temperature		
	24° or lower	28° or lower	32° or lower
Spring:			
9 years in 10 later than ---	April 20	May 2	May 21
5 years in 10 later than ---	May 8	May 19	June 7
1 year in 10 later than ---	May 24	June 5	June 24
Fall:			
9 years in 10 earlier than --	October 16	October 5	September 18
5 years in 10 earlier than --	September 27	September 16	August 30
1 year in 10 earlier than --	September 8	August 28	August 11

BABB			
Probability	Dates for given probability and temperature		
	24° or lower	28° or lower	32° or lower
Spring:			
9 years in 10 later than ---	April 23	May 8	May 26
5 years in 10 later than ---	May 10	May 25	June 12
1 year in 10 later than ---	May 26	June 11	June 28
Fall:			
9 years in 10 earlier than --	October 14	October 6	September 5
5 years in 10 earlier than --	September 19	September 11	August 11
1 year in 10 earlier than --	August 25	August 17	July 17

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.

TABLE 12.—Average annual frost-free days at locations in the survey area

Location	Temperature of—		
	24° or lower	28° or lower	32° or lower
	Days	Days	Days
Cut Bank -----	158	130	108
Browning -----	142	120	84
Babb -----	133	109	60

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 and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity. **Somewhat excessively drained** soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sand-blast) and running water. Hazards of wind and water erosion are rated *slight*, *moderate*, or *severe*. Cropland is rated on the basis of cultivated soil; range, on infrequent cultivation or intensive surface disturbance by grazing, insects, hail, or drought; and woodland, on normal clear cut harvest or infrequent natural burn.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Glacial till (geology). Cross-bedded gravel, sand, and silt deposited by melt water as it flows from glacial ice.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

- O horizon.**—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.
- A horizon.**—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).
- 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 some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.
- C horizon.**—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.
- R layer.**—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.
- Humus.** The well-decomposed, more or less stable part of the organic matter in mineral soils.
- Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.
- Large stones.** Rock fragments 10 inches or more across affect the specific use.
- Mottling, soil.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.
- Organic matter.** A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.
- Parent material.** Disintegrated and partly weathered rock from which soil has formed.
- Permeability.** The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid*.
- Profile, soil.** A vertical section of the soil through all its horizons and extending into the parent material.
- Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

<p style="text-align: center;">pH</p> <p>Extremely acid ---- Below 4.5</p> <p>Very strongly acid _4.5 to 5.0</p> <p>Strongly acid -----5.1 to 5.5</p> <p>Medium acid -----5.6 to 6.0</p> <p>Slightly acid -----6.1 to 6.5</p>	<p style="text-align: center;">pH</p> <p>Neutral -----6.6 to 7.3</p> <p>Mildly alkaline ----7.4 to 7.8</p> <p>Moderately alkaline_7.9 to 8.4</p> <p>Strongly alkaline --8.5 to 9.0</p> <p>Very strongly alkaline ---9.1 and higher</p>
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- Relief.** The elevations or inequalities of a land surface, considered collectively.
- Saline soil.** A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.
- Sand.** Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.
- Series, soil.** A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.
- Silt.** Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.
- Slick spots.** Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.
- Small stones.** Rock fragments that are less than 10 inches across may affect the specific use. Included are cobbles, pebbles, and channers.
- Soil.** A natural, three-dimensional body on the earth's surface that supports plants and that 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.
- Solum.** The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes 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.
- Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 together without any regular cleavage, as in many claypans and hardpans).
- Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.
- Substratum.** Technically, the part of the soil below the solum.
- Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.
- Terrace (geological).** An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.
- Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."
- Upland (geology).** Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs.

Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page			
						Name	Symbol	Number	
AB	Adel-Babb complex, hilly-----	15	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
	Adel part-----	--	-----	--	-----	--	-----	4c1	---
	Babb part-----	--	-----	--	-----	--	-----	5o2	---
Ac	Absher complex-----	14	VIIs-1	80	-----	--	Dense Clay, 12- to 14-inch	---	4
Ad	Adel loam, 0 to 4 percent slopes-----	15	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	1
Ae	Adel loam, 4 to 10 percent slopes-----	15	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1
AF	Adel-Fifer association, hilly-----	15	VIe-1	80	-----	--	-----	---	4
	Adel part-----	--	-----	--	-----	--	Silty, 15- to 19-inch	---	---
	Fifer part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	---
Ag	Arnegard loam, 0 to 2 percent slopes-----	16	IIIe-1	78	-----	--	Silty, 15- to 19-inch	---	1
Ah	Arnegard loam, 2 to 8 percent slopes-----	16	IIIe-2	78	-----	--	Silty, 15- to 19-inch	---	1
Ak	Attewan sandy loam, 0 to 4 percent slopes-----	17	IIIe-4	78	-----	--	Sandy, 12- to 14-inch	---	2M
AL	Adel-Hanson complex, hilly-----	16	VIe-1	80	-----	--	Silty, 20- to 24-inch	---	4
Am	Attewan sandy loam, 4 to 8 percent slopes-----	17	IIIe-3	78	-----	--	Sandy, 12- to 14-inch	---	2M
An	Attewan loam, 0 to 4 percent slopes-----	17	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2M
Ao	Attewan loam, 4 to 8 percent slopes-----	17	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2M
Ba	Babb cobbly loam, undulating-----	18	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	1
Bb	Babb cobbly loam, gently rolling-----	18	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1
BC	Babb cobbly loam, hilly-----	18	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
Bd	Babb sandy loam, sandy subsoil variant, undulating-----	19	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	2M
Be	Bear Lake silty clay loam-----	20	Vw-1	80	-----	--	Subirrigated, 12- to 19-inch	---	3W
BF	Babb-Hanson complex, hilly-----	18	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
Bg	Bearmouth gravelly loam, 0 to 4 percent slopes-----	20	VIIs-1	80	-----	--	Shallow to Gravel, 15- to 19-inch	---	4
BG	Babb sandy loam, sandy subsoil variant, hilly-----	19	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
Bh	Beaverton gravelly loam, 0 to 4 percent slopes-----	21	IVs-1	79	-----	--	Shallow to Gravel, 12- to 14-inch	---	3M

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol	Number
Bk	Beaverton-Williams complex, undulating- Beaverton part-----	21	IVs-1	79	-----	--	----- Shallow to Gravel, 12- to 14-inch	---	---
	Williams part-----	--	-----	--	-----	--	Silty, 12- to 14-inch	---	1
BL	Badland-----	19	VIIIIs-1	81	-----	--	-----	---	4
BM	Bridger-Mord association, hilly----- Bridger part-----	22	VIe-1	80	-----	--	----- Silty, 20- to 24-inch	---	4
	Mord part-----	--	-----	--	-----	--	-----	4o1	---
BN	Bridger-Rock land association, very steep-----	22	-----	--	-----	--	-----	---	---
	Bridger part-----	--	VIe-1	80	-----	--	Silty, 20- to 24-inch	---	4
	Rock land part-----	--	VIIIIs-1	81	-----	--	-----	---	---
Bo	Boxwell complex, undulating-----	21	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2M
BP	Burnette stony loam, hilly-----	24	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
Br	Brockway silt loam, 0 to 2 percent slopes-	23	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Bs	Brockway silt loam, 2 to 4 percent slopes-	23	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Bt	Brockway silt loam, 4 to 8 percent slopes-	23	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Bu	Burnette loam, undulating-----	24	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1
Bv	Bynum silt loam, undulating-----	25	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	2M
BW	Burnette-Adel association, rolling----	24	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	1
By	Bynum-Fifer complex, rolling-----	25	IVe-2	79	-----	--	----- Silty, 15- to 19-inch	---	2M
	Bynum part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	3M
	Fifer part-----	--	-----	--	-----	--	-----	---	---
Ca	Cabba loam, undulating-----	25	IVs-2	80	-----	--	Shallow, 12- to 14-inch	---	3M
Cb	Cabba loam, hilly-----	25	VIe-1	80	-----	--	Shallow, 12- to 14-inch	---	4
Ce	Cabba-Reeder complex, undulating-----	25	IIIe-2	78	-----	--	-----	---	---
	Cabba part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	3M
	Reeder part-----	--	-----	--	-----	--	Silty, 12- to 14-inch	---	2M
CK	Cabba-Rock outcrop complex, very steep- Cabba part-----	26	VIIe-1	80	-----	--	----- Shallow, 12- to 14-inch	---	4
	Rock outcrop part-	--	-----	--	-----	--	-----	---	---
Cn	Castner-Cabba complex, sloping-----	26	VIIs-1	80	-----	--	Shallow, 12- to 14-inch	---	3M
Co	Castner-Cabba complex, steep-----	26	VIIs-1	80	-----	--	Shallow, 12- to 14-inch	---	4
CR	Castner-Rock outcrop complex, very steep- Castner part-----	26	VIIe-1	80	-----	--	----- Shallow, 12- to 14-inch	---	4
	Rock outcrop part-	--	-----	--	-----	--	-----	---	---
CV	Crago-Kiev association, steep-----	27	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
Dc	Dimmick clay-----	28	IVw-1	79	-----	--	Overflow, 12- to 14-inch	---	4

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol	Number
DH	Doby-Burnette complex, hilly-----	28	VIe-1	80	-----	--	-----	---	4
	Doby part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	---
	Burnette part-----	--	-----	--	-----	--	Clayey, 15- to 19-inch	---	---
DL	Doby-Hanson complex, rolling-----	28	VIe-1	80	-----	--	-----	---	3M
	Doby part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	---
	Hanson part-----	--	-----	--	-----	--	Clayey, 15- to 19-inch	---	---
DS	Doby-Shale outcrop complex, very steep-	29	VIIe-1	80	-----	--	-----	---	---
	Doby part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	4
	Shale outcrop part	--	-----	--	-----	--	-----	---	---
DU	Dune land-----	29	VIe-1	80	-----	--	Clayey, 15- to 19-inch	---	4
Ec	Ethridge clay loam, sand substratum, 0 to 2 percent slopes-	30	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L
Ed	Ethridge clay loam, sand substratum, 2 to 4 percent slopes-	30	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L
Ee	Ethridge clay loam, sand substratum, 4 to 8 percent slopes-	30	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L
Eg	Ethridge silty clay loam, 0 to 2 percent slopes-----	30	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	2L
Eh	Ethridge silty clay loam, 2 to 4 percent slopes-----	30	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	2L
Em	Ethridge-Absher clay loams, 0 to 2 percent slopes-----	30	IIIe-3	78	-----	--	-----	---	---
	Ethridge part-----	--	-----	--	-----	--	Clayey, 12- to 14-inch	---	2L
	Absher part-----	--	-----	--	-----	--	Dense Clay, 12- to 14-inch	---	4
Fa	Fairfield loam, 0 to 2 percent slopes----	31	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Fb	Fairfield loam, 2 to 4 percent slopes----	31	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Fc	Fairfield loam, 4 to 8 percent slopes----	31	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Fd	Fairfield gravelly loam, 0 to 2 percent slopes-----	31	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Fe	Fairfield gravelly loam, 2 to 4 percent slopes-----	31	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Ff	Fairfield gravelly loam, 4 to 8 percent slopes-----	31	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L
Fg	Fairfield cobbly loam, 0 to 4 percent slopes-----	32	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	3L
Fh	Fairfield-Cabba complex, sloping----	32	IIIe-3	78	-----	--	-----	---	---
	Fairfield part-----	--	-----	--	-----	--	Silty, 12- to 14-inch	---	3L
	Cabba part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	3M

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol	Number
Fk	Fairfield-Utica								
	gravelly loams, 0 to 2 percent slopes-	32	IIIe-3	78	-----	--	-----	---	3L
	Fairfield part----	--	-----	--	-----	--	Silty, 12- to 14-inch	---	---
	Utica part-----	--	-----	--	-----	--	Shallow to Gravel, 12- to 14-inch	---	---
Fm	Farnuf loam, 0 to 2 percent slopes-----	32	IIIe-1	78	-----	--	Silty, 15- to 19-inch	---	1
Fn	Farnuf cobbly loam, 0 to 2 percent slopes-	33	IIIe-1	78	-----	--	Silty, 15- to 19-inch	---	2L
Fo	Farnuf cobbly loam, 2 to 4 percent slopes-	33	IIIe-2	78	-----	--	Silty, 15- to 19-inch	---	2L
Fr	Farnuf cobbly loam, 4 to 8 percent slopes-	33	IIIe-2	78	-----	--	Silty, 15- to 19-inch	---	2L
Fs	Farnuf cobbly loam, 8 to 15 percent slopes-----	33	IVe-2	79	-----	--	Silty, 15- to 19-inch	---	2L
Ft	Fifer loam, hilly-----	33	VIe-1	80	-----	--	Shallow, 15- to 19-inch	---	4
FU	Fifer-Cheadle-Rock outcrop complex, very steep-----	34	VIIe-1	80	-----	--	-----	---	---
	Fifer part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	4
	Cheadle part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	4
	Rock outcrop part-	--	-----	--	-----	--	-----	---	---
FV	Fifer-Raynesford complex, hilly-----	34	VIe-1	80	-----	--	-----	---	4
	Fifer part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	---
	Raynesford part---	--	-----	--	-----	--	Silty, 15- to 19-inch	---	---
FW	Fresh water swamp-----	34	VIIIw-1	80	-----	--	-----	---	4
Ga	Gallatin loam-----	34	IIIw-1	78	-----	--	-----	---	1
Gc	Gapo clay loam-----	35	Vw-1	80	-----	--	Subirrigated, 12- to 19-inch	---	3W
Gd	Gapo clay loam, drained-----	35	IVe-4	79	-----	--	Clayey, 15- to 19-inch	---	2W
GL	Garlet stony loam, very steep-----	36	VIIe-1	80	-----	--	-----	6x1	4
HA	Hanson stony loam, steep-----	36	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
HF	Hanson-Fifer complex, rolling-----	36	VIe-1	80	-----	--	-----	---	3M
	Hanson part-----	--	-----	--	-----	--	Silty, 15- to 19-inch	---	---
	Fifer part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	---
HR	Hanson-Raynesford complex, undulating-	36	VIe-1	80	-----	--	-----	---	---
	Hanson part-----	--	-----	--	-----	--	-----	---	3M
	Raynesford part---	--	-----	--	-----	--	-----	---	2L
HS	Hanson-Raynesford complex, rolling----	37	VIe-1	80	-----	--	-----	---	---
	Hanson part-----	--	-----	--	-----	--	-----	---	3M
	Raynesford part---	--	-----	--	-----	--	-----	---	2L
Ka	Kevin loam, 2 to 4 percent slopes-----	37	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2L
Kb	Kevin loam, 4 to 8 percent slopes-----	37	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2L
Kc	Kevin clay loam, 2 to 4 percent slopes----	38	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L

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Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone		Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol		
Kd	Kevin clay loam, 4 to 8 percent slopes----	38	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L	
Ke	Kevin clay loam, 8 to 15 percent slopes---	38	IVe-3	79	-----	--	Clayey, 12- to 14-inch	---	2L	
Kg	Kiev loam, 2 to 4 percent slopes-----	38	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L	
Kh	Kiev loam, shale substratum, 2 to 4 percent slopes-----	38	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L	
Kk	Kiev loam, shale substratum, 4 to 8 percent slopes-----	39	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L	
Km	Kiev loam, shale substratum, 8 to 15 percent slopes-----	39	IVe-3	79	IVe-1	82	Silty, 12- to 14-inch	---	3L	
Kn	Kiev gravelly loam, 0 to 2 percent slopes---	39	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L	
Ko	Kiev gravelly loam, 2 to 4 percent slopes---	39	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L	
Kp	Kiev gravelly loam, 4 to 8 percent slopes---	39	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	3L	
Kr	Kiev gravelly loam, 8 to 15 percent slopes-----	39	IVe-3	79	IVe-1	82	Silty, 12- to 14-inch	---	3L	
Ks	Kiwanis fine sandy loam-----	40	IIIe-4	78	IIIs-1	82	Sandy, 12- to 14-inch	---	3M	
Kt	Korchea loam, 0 to 2 percent slopes-----	40	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	1	
Ku	Korchea loam, 2 to 4 percent slopes-----	40	IIIe-3	78	IIIe-1	82	Silty, 12- to 14-inch	---	1	
KV	Korchea and Kiwanis soils-----	40	VIw-1	80	-----	--	Overflow, 12- to 14-inch	---	1	
Kw	Kuro-Timberg complex, rolling-----	41	VIIs-1	80	-----	--	-----	---	---	
	Kuro part-----	--	-----	--	-----	--	Shallow, 15- to 19-inch	---	3M	
	Timberg part-----	--	-----	--	-----	--	Clayey, 15- to 19-inch	---	2M	
La	Leavitt cobbly loam, 0 to 2 percent slopes-----	41	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	1	
Lb	Leavitt cobbly loam, 2 to 4 percent slopes---	42	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	1	
Lc	Leavitt cobbly loam, 4 to 8 percent slopes---	42	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1	
Ld	Leavitt cobbly loam, 8 to 15 percent slopes-----	42	IVe-2	79	-----	--	Silty, 15- to 19-inch	---	1	
Le	Leavitt complex, undulating-----	42	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1	
LF	Leavitt complex, hilly-----	42	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4	
LG	Libeg stony loam, very steep-----	43	VIIe-1	80	-----	--	Silty, 15- to 19-inch	---	4	
LH	Libeg-Adel complex, rolling-----	43	VIe-1	80	-----	--	Silty, 20- to 24-inch	---	4	
Lk	Linnet clay, 0 to 2 percent slopes-----	44	IIIe-3	78	IIIs-2	82	Clayey, 12- to 14-inch	---	1	

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Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol	Number
Lm	Linnet clay, 2 to 4 percent slopes-----	44	IIIe-3	78	IIIe-2	82	Clayey, 12- to 14-inch	---	1
Ln	Linnet clay, 4 to 8 percent slopes-----	44	IIIe-3	78	IVe-1	82	Clayey, 12- to 14-inch	---	1
Lo	Linnet clay, gravelly substratum, 0 to 2 percent slopes-----	44	IIIe-3	78	IIIs-2	82	Clayey, 12- to 14-inch	---	2M
Lp	Linnet clay, gravelly substratum, 2 to 4 percent slopes-----	44	IIIe-3	78	IIIe-2	82	Clayey, 12- to 14-inch	---	2M
Lr	Litimber clay loam, 2 to 4 percent slopes-----	45	IIIe-2	78	-----	--	Clayey, 15- to 19-inch	---	1
Ls	Litimber clay loam, 4 to 8 percent slopes-----	45	IIIe-2	78	-----	--	Clayey, 15- to 19-inch	---	1
Lt	Litimber cobbly clay loam, undulating-----	45	IIIe-2	78	-----	--	Clayey, 15- to 19-inch	---	2M
Lu	Litimber complex, 2 to 8 percent slopes-----	45	IIIe-2	78	-----	--	Clayey, 15- to 19-inch	---	2M
LV	Loberg-Mord association, hilly--	46	VIe-1	80	-----	--	-----	---	4
	Loberg part-----	--	-----	--	-----	--	-----	5ol	---
	Mord part-----	--	-----	--	-----	--	Silty, 20- to 24-inch	---	---
LW	Loberg-Whitore association, very steep-----	46	-----	--	-----	--	-----	---	4
	Loberg part-----	--	VIe-1	80	-----	--	-----	5r1	---
	Whitore part-----	--	VIIe-1	80	-----	--	-----	7f2	---
LY	Loberg soils, hilly--	46	VIe-1	80	-----	--	-----	5ol	4
Ma	Martinsdale loam, 0 to 2 percent slopes-----	47	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2L
Mb	Martinsdale loam, 2 to 4 percent slopes-----	47	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2L
Mc	Martinsdale loam, 4 to 8 percent slopes-----	47	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2L
Md	Martinsdale gravelly loam, 2 to 4 percent slopes-----	47	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	2L
Me	Martinsdale clay loam, 0 to 2 percent slopes-----	47	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L
Mf	Martinsdale clay loam, 2 to 4 percent slopes-----	47	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L
Mg	Martinsdale clay loam, 4 to 8 percent slopes-----	47	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2L
Mh	Martinsdale clay loam, 8 to 15 percent slopes-----	47	IVe-3	79	-----	--	Clayey, 12- to 14-inch	---	2L
Mk	Martinsdale gravelly clay loam, 0 to 2 percent slopes-----	48	IIIe-3	78	IIIe-1	82	Clayey, 12- to 14-inch	---	2L
Mm	Martinsdale gravelly clay loam, 2 to 4 percent slopes-----	48	IIIe-3	78	IIIe-1	82	Clayey, 12- to 14-inch	---	2L

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Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol	Number
Mn	Martinsdale gravelly clay loam, 4 to 8 percent slopes-----	48	IIIe-3	78	IIIe-1	82	Clayey, 12- to 14-inch	---	2L
Mo	Michelson loam, 0 to 2 percent slopes-----	48	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	2L
Mp	Michelson loam, 2 to 4 percent slopes-----	49	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	2L
Mr	Michelson loam, 4 to 8 percent slopes-----	49	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	2L
Ms	Michelson loam, 8 to 15 percent slopes---	49	IVe-3	79	-----	--	Silty, 15- to 19-inch	---	2L
Mt	Michelson cobbly loam, 0 to 2 percent slopes-----	49	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	2L
Mu	Michelson cobbly loam, 2 to 4 percent slopes-----	49	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	2L
Mv	Michelson cobbly loam, 4 to 8 percent slopes-----	49	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	2L
Mw	Michelson cobbly loam, 8 to 15 percent slopes-----	49	IVe-2	79	-----	--	Silty, 15- to 19-inch	---	2L
Mx	Michelson stony loam, 0 to 4 percent slopes-----	49	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	2L
My	Mikesell clay loam, hilly-----	50	VIe-1	80	-----	--	-----	5cl	4
Mz	Mord loam, sloping----	51	IVe-2	79	-----	--	Silty, 20- to 24-inch	---	1
MZb	Mixed alluvial land---	50	VIw-1	80	-----	--	Overflow, 12- to 14-inch	---	4
MZc	Mord stony loam, steep-----	51	VIe-1	80	-----	--	Silty, 20- to 24-inch	---	4
NB	Nettleton-Burnette association, undulating-----	51	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1
Nc	Nishon clay loam-----	52	IVw-1	79	-----	--	Overflow, 12- to 14-inch	---	4
NM	Nettleton and Mikesell clay loams, hilly---	52	VIe-1	80	-----	--	-----	5cl	4
No	Novary loam-----	53	Vw-1	80	-----	--	Subirrigated, 12- to 19-inch	---	3W
PA	Peat-----	53	Vw-1	80	-----	--	Wet Land, 12- to 19-inch	---	4
Pc	Pendroy clay, 0 to 2 percent slopes-----	53	IIIe-3	78	IIIIs-2	82	Clayey, 12- to 14-inch	---	1
Pd	Pendroy clay, 2 to 4 percent slopes-----	53	IIIe-3	78	IIIe-2	82	Clayey, 12- to 14-inch	---	1
Pe	Pendroy clay, 4 to 8 percent slopes-----	54	IIIe-3	78	IVe-1	82	Clayey, 12- to 14-inch	---	1
Pf	Pendroy clay, shale substratum-----	54	IIIe-3	78	-----	--	Dense Clay, 12- to 14-inch	---	4
PH	Pishkun-Adel association, steep-----	54	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
PL	Playas-----	54	VIIIs-1	80	-----	--	Saline Upland, 12- to 14-inch	---	4

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Map symbol	Mapping unit	Page	Capability unit				Range site and precipitation zone	Woodland suitability group	Windbreak suitability group
			Dryland	Page	Irrigated	Page	Name	Symbol	Number
RC	Raynesford-Bear Lake complex, rolling----	55	VIe-1	80	-----	--	-----	---	---
	Raynesford part----	--	-----	--	-----	--	Silty, 15- to 19-inch	---	2L
	Bear Lake part----	--	-----	--	-----	--	Subirrigated, 12- to 19-inch	---	3W
RD	Raynesford-Hanson complex, hilly-----	55	VIe-1	80	-----	--	Silty, 15- to 19-inch	---	4
Re	Redchief cobbly loam, gently sloping-----	56	IVe-4	79	-----	--	Silty, 15- to 19-inch	---	1
Rf	Redchief cobbly loam, sloping-----	56	IVe-1	78	-----	--	Silty, 15- to 19-inch	---	1
Rg	Reeder silt loam, undulating-----	56	IIIe-2	78	-----	--	Silty, 12- to 14-inch	---	2M
Rh	Reeder-Arnegard complex, undulating-	57	IIIe-2	78	-----	--	Silty, 12- to 14-inch	---	---
	Reeder part-----	--	-----	--	-----	--	-----	---	2M
	Arnegard part-----	--	-----	--	-----	--	-----	---	---
RK	Rentsac-Rock outcrop complex, very steep-	57	VIIe-1	80	-----	--	-----	---	---
	Rentsac part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	4
	Rock outcrop part-	--	-----	--	-----	--	-----	---	---
Rm	Rentsac stony loam, undulating-----	57	VIIs-1	80	-----	--	Shallow, 12- to 14-inch	---	4
Rn	Rentsac stony loam, rolling-----	57	VIIs-1	80	-----	--	Shallow, 12- to 14-inch	---	4
Ro	Rhoades complex-----	58	VIIs-1	80	-----	--	Clayey, 15- to 19-inch	---	4
RS	Riverwash-----	59	VIIIIs-1	81	-----	--	-----	---	4
RT	Rock outcrop-----	59	VIIIIs-1	81	-----	--	-----	---	4
SA	Saline land-----	59	VIW-1	80	-----	--	Saline Lowland, 12- to 19-inch	---	4
Sb	Savage clay loam, 0 to 2 percent slopes-	60	IIIe-1	78	IIIe-1	82	Clayey, 12- to 14-inch	---	1
Sc	Savage clay loam, 2 to 4 percent slopes-	60	IIIe-2	78	IIIe-1	82	Clayey, 12- to 14-inch	---	1
Sd	Savage clay loam, undulating-----	60	IIIe-2	78	-----	--	Clayey, 12- to 14-inch	---	1
Se	Savage-Rhoades clay loams, 0 to 4 percent slopes-----	60	IIIe-1	78	-----	--	Clayey, 15- to 19-inch	---	---
	Savage part-----	--	-----	--	-----	--	-----	---	1
	Rhoades part-----	--	-----	--	-----	--	-----	---	4
Sf	Savage-Wayden clay loams, rolling-----	60	IVe-3	79	-----	--	-----	---	---
	Savage part-----	--	-----	--	-----	--	Clayey, 12- to 14-inch	---	1
	Wayden part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	3M
Sg	Scobey clay loam, 2 to 4 percent slopes-	61	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	1
Sh	Scobey clay loam, 4 to 8 percent slopes-	61	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	1
Sk	Scobey-Kevin loams, undulating-----	61	IIIe-3	78	-----	--	Silty, 12- to 14-inch	---	---
	Scobey part-----	--	-----	--	-----	--	-----	---	1
	Kevin part-----	--	-----	--	-----	--	-----	---	2L
Sm	Scobey-Kevin loams, rolling-----	61	IVe-3	79	-----	--	Silty, 12- to 14-inch	---	---
	Scobey part-----	--	-----	--	-----	--	-----	---	1
	Kevin part-----	--	-----	--	-----	--	-----	---	2L

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Map symbol	Mapping unit	Page	Capability unit			Range site and precipitation zone		Woodland suitability group	Windbreak suitability group
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Sn	Scobey-Kevin clay loams, undulating---	61	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	---
	Scobey part-----	--	-----	--	-----	--	-----	---	1
	Kevin part-----	--	-----	--	-----	--	-----	---	2L
SO	Scobey-Zahl complex, hilly-----	61	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
SP	Seeped alluvial land--	62	Vw-1	80	-----	--	Subirrigated, 12- to 19-inch	---	3W
Sr	Sherburne gravelly loam, sloping-----	63	IVe-1	78	-----	--	-----	5o1	2M
SS	Sherburne gravelly loam, steep-----	63	VIe-1	80	-----	--	-----	5r1	4
ST	Stony land-----	63	VIIIIs-1	81	-----	--	-----	---	4
SU	Sunburst clay, steep--	63	VIe-1	80	-----	--	Clayey, 12- to 14-inch	---	4
SV	Swifton-Mikesell association, hilly--	64	VIe-1	80	-----	--	-----	---	4
	Swifton part-----	--	-----	--	-----	--	-----	5o1	---
	Mikesell part-----	--	-----	--	-----	--	-----	5c1	---
SW	Swifton-Mord-Rock land association, very steep-----	64	-----	--	-----	--	-----	---	4
	Swifton part-----	--	VIe-1	80	-----	--	-----	5r1	---
	Mord part-----	--	VIe-1	80	-----	--	Silty, 20- to 24-inch	---	---
	Rock land part-----	--	VIIIIs-1	81	-----	--	-----	---	---
SX	Swifton-Garlet association, hilly--	64	VIe-1	80	-----	--	-----	---	4
	Swifton part-----	--	-----	--	-----	--	-----	5o1	---
	Garlet part-----	--	-----	--	-----	--	-----	6x1	---
Ta	Tally sandy loam, 0 to 2 percent slopes-	65	IIIe-4	78	-----	--	Sandy, 12- to 14-inch	---	2M
Tb	Tally sandy loam, undulating-----	65	IIIe-4	78	-----	--	Sandy, 12- to 14-inch	---	2M
Tc	Tally sandy loam, rolling-----	65	IIIe-4	78	-----	--	Sandy, 12- to 14-inch	---	2M
TD	Tally complex, sloping-----	65	VIe-1	80	-----	--	Sandy, 12- to 14-inch	---	3M
Te	Tanna clay loam, 2 to 4 percent slopes---	66	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2M
Tf	Tanna clay loam, 4 to 8 percent slopes---	66	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2M
Tg	Tanna-Absher clay loams-----	66	IIIe-3	78	-----	--	-----	---	---
	Tanna part-----	--	-----	--	-----	--	Clayey, 12- to 14-inch	---	2M
	Absher part-----	--	-----	--	-----	--	Dense Clay, 12- to 14-inch	---	4
Th	Tanna-Wayden clay loams, rolling-----	66	IVe-3	79	-----	--	-----	---	---
	Tanna part-----	--	-----	--	-----	--	Clayey, 12- to 14-inch	---	2M
	Wayden part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	3M
TK	Tenex cobbly loam, hilly-----	67	VIe-1	80	-----	--	-----	6o1	2M
TL	Terrace escarpments and Fairfield soils-	67	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
Tm	Thebo clay, undulating-----	68	IIIe-3	78	-----	--	Clayey, 12- to 14-inch	---	2M
Tn	Timberg clay loam, undulating-----	68	IIIe-2	78	-----	--	Clayey, 15- to 19-inch	---	2M

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			Dryland	Page	Irrigated	Page	Name	Symbol	Number
TN	Tinsley soils-----	69	VIIIs-1	80	-----	--	Gravel, 15- to 19-inch	---	4
To	Turner loam, 0 to 4 percent slopes-----	69	IIIe-4	78	IIIIs-1	82	Silty, 12- to 14-inch	---	3M
Tr	Turner cobbly loam, 0 to 4 percent slopes-----	69	IIIe-4	78	IIIIs-1	82	Silty, 12- to 14-inch	---	3M
Ts	Turner-Beaverton loams, 0 to 4 percent slopes-----	69	IVs-1	79	-----	--	-----	---	3M
	Turner part-----	--	-----	--	-----	--	Silty, 12- to 14-inch	---	---
	Beaverton part-----	--	-----	--	-----	--	Shallow to Gravel, 12- to 14-inch	---	---
Ua	Utica very gravelly sandy loam-----	70	VIIs-1	80	-----	--	Shallow to Gravel, 12- to 14-inch	---	4
Va	Vanda clay-----	71	VIIs-1	80	-----	--	Dense Clay, 12- to 14-inch	---	4
Wa	Wayden clay loam, undulating-----	71	IVs-2	80	-----	--	Shallow, 12- to 14-inch	---	3M
Wb	Wayden clay loam, hilly-----	71	VIe-1	80	-----	--	Shallow, 12- to 14-inch	---	4
Wc	Wayden-Absher complex, undulating-----	71	VIIs-1	80	-----	--	-----	---	---
	Wayden part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	3M
	Absher part-----	--	-----	--	-----	--	Dense Clay, 12- to 14-inch	---	4
WD	Wayden-Shale outcrop complex, steep-----	71	VIIIs-1	80	-----	--	-----	---	4
	Wayden part-----	--	-----	--	-----	--	Shallow, 12- to 14-inch	---	---
	Shale outcrop part-----	--	-----	--	-----	--	-----	---	---
WE	Wet alluvial land-----	72	Vw-1	80	-----	--	Wet Land, 12- to 19-inch	---	4
WF	Wet land-----	72	Vw-1	80	-----	--	Subirrigated, 12- to 19-inch	---	4
WG	Whitore stony loam, hilly-----	73	VIe-1	80	-----	--	-----	7f2	4
WH	Whitore complex, rolling-----	73	VIe-1	80	-----	--	-----	7f1	3L
Wk	Williams cobbly loam, gently sloping-----	73	IIIe-2	78	-----	--	Silty, 12- to 14-inch	---	1
WL	Whitore complex, hilly-----	73	VIe-1	80	-----	--	-----	7f1	4
Wm	Williams cobbly loam, undulating-----	74	IIIe-2	78	-----	--	Silty, 12- to 14-inch	---	1
WN	Williams complex, hilly-----	74	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
WO	Williams complex, steep-----	74	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
Wr	Williams-Zahl complex, undulating-----	74	IIIe-2	78	-----	--	Silty, 12- to 14-inch	---	1
WS	Williams-Zahl complex, hilly-----	74	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
WT	Williams-Zahl complex, steep-----	74	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4
Ye	Yetull fine sand-----	75	VIIs-1	80	-----	--	Sandy, 12- to 14-inch	---	3M
ZA	Zahl complex, hilly---	75	VIe-1	80	-----	--	Silty, 12- to 14-inch	---	4

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