SOIL SURVEY OF

Riverton Area, Wyoming

(Fremont County)

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Wyoming Agricultural Experiment Station

Issued December 1974

Major fieldwork for this soil survey was done in the period 1963–67. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the area at the time the survey was completed. This survey was made cooperatively by the Soil Conservation Service and the Wyoming Agricultural Experiment Station. It is part of the technical assistance furnished to the Pavillion and Wind River Conservation Districts. In 1969 the Pavillion and Wind River Conservation Districts were combined to form the Riverton Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

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 Riverton 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 survey 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 page for the 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 discussion of the capability units, the range sites, and the windbreak suitability groups.

Foresters and others can refer to the section "Management of the Soils for Windbreaks," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Management of the Soils for Wildlife."

Ranchers and others can find, under "Management of the Soils for 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.

Community planners and others will find many of the sections helpful in planning urban uses of soils, particularly "Management of the Soils for Urban and Recreational Uses."

Engineers and builders 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 in the survey 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 county given in the section "General Nature of the Area."

Cover: **Cattle grazing on irrigated pasture on a Lostwells sandy clay loam.**

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Contents

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SOIL SURVEY OF RIVERTON AREA, WYOMING (FREMONT COUNTY)

BY JACK F. YOUNG, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY JACK F. YOUNG AND CLARENCE J. FOWKES, SOIL CONSERVATION SERVICE [1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WYOMING AGRICULTURAL EXPERIMENT STATION

THE RIVERTON AREA is in the central part of Fremont County, Wyoming (fig. 1). It has a total area of 375,432 acres, or about 587 square miles. Riverton is the largest town in the survey area.

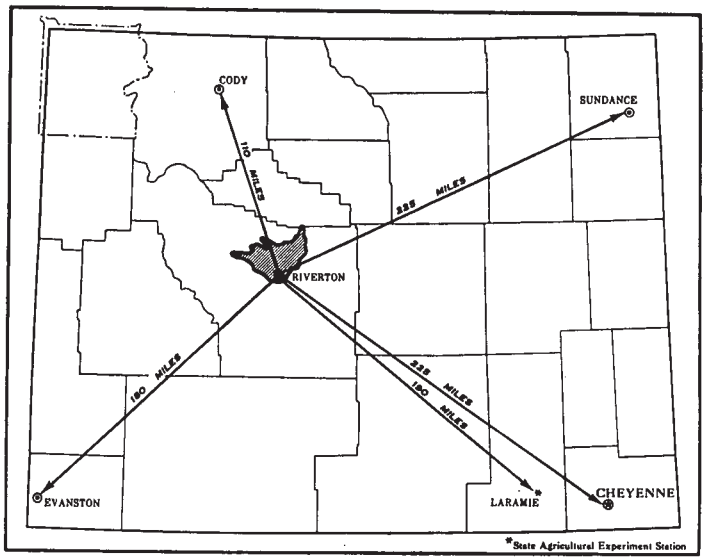

Figure 1.—Location of Riverton Area in Wyoming.

Most of the survey area is in the Wind River Basin (*2*).[2] The northwestern part of the survey area is where the Owl Creek and Bridger Mountains join. The Wind River Basin is the western part of the Shoshoni Basin, which is a subordinate basin of the Wyoming Basin. The Owl Creek and Bridger Mountains are part of the Middle Rocky Mountains. The main part of the survey area is in the Northern Intermountain Desertic Basin Major Land Resource Area. The mountainous part is in the Semiarid Rocky Mountains Major Land Resource Area. The survey area is drained by the Wind River and its tributaries.

Sugar beets, dry beans, alfalfa, small grain, and corn are the principal crops grown under irrigation. Much of the land is used for grazing by cattle and sheep. Cattle and sheep are fattened for market on farms. Many colonies of bees pollenate the alfalfa fields.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Riverton Area, where they are located, and how they can be used. The soil scientists went into the survey area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many other 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 (*5*). 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. Apron and Bigwin, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects their use by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management.

[1] Others who contributed to this soil survey are WILLIAM R. GLENN, JOHN E. IIAMS, E. GARY ROBBINS, and ARLYN R. SHINEMAN. ARVAD J. CLINE and CLARENCE J. FOWKES assisted in the field correlation. All are or were soil scientists with the Soil Conservation Service.

[2] Italic numbers in parentheses refer to Literature Cited, p. 85.

For example, Apron sandy loam, 0 to 3 percent slopes, is one of several phases within the Apron series.

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

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 predominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of the survey area: soil complexes and soil associations.

A soil complex consists of areas of two or more soils, so intricately mixed 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. Birdsley-Boysen complex, 0 to 10 percent slopes, 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, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Enos-Wall association, gently sloping, 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. Marsh and Rock land are land types in this survey area.

While a soil survey is in progress, soil scientists take soil samples as 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 the soils behave when used as a growing place for native and cultivated plants, and as material, foundations, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that absorption 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 a high water table. They see that streets, road pavements, and foundations for houses are cracked on a certain 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 Riverton 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 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 mangement 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 terms for texture used in the title of the associations apply to the texture of the surface layer. For example, in the Apron-Lostwells association the words "sandy loams and sandy clay loams" refer to the texture of the surface layer.

The soil associations in the survey area are discussed in the following pages.

1. Apron-Lostwells Association

Deep, nearly level to sloping sandy loams and sandy clay loams; on alluvial fans

This association consists of deep, well-drained sandy loams and sandy clay loams on alluvial fans. Slopes are 0 to 10 percent (fig. 2). These soils formed in alluvium derived from sandstone and clay shale. The principal areas of this association are between Pilot Butte and Lost Wells Butte and in the Missouri Valley. Riverview, Riverton Valley, and Hidden Valley are also important areas. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free season is 120 to 140 days. Elevation ranges from 4,800 to 5,500 feet.

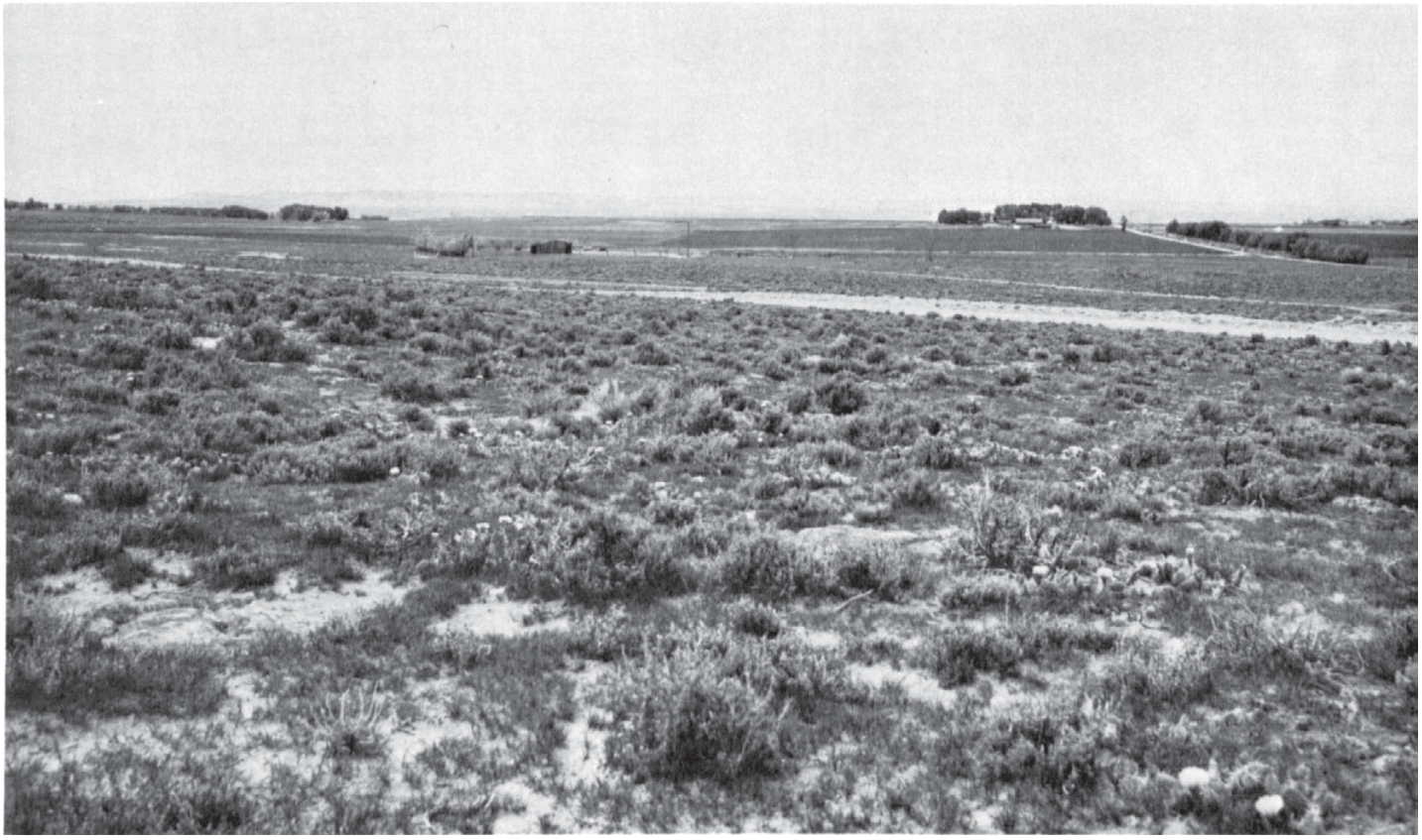

Figure 2.—**Part of the Apron-Lostwells association looking east from a point northeast of Pilot Butte Reservoir. The fields in the background are in alfalfa.**

This association occcupies about 38 percent of the survey area. Apron soils make up about 30 percent of the association and Lostwells soils about 25 percent. Minor soils make up the remaining 45 percent.

Apron soils are light brownish-gray to light yellowish-brown sandy loam to a depth of 60 inches or more. Lostwells soils are light brownish-gray stratified sandy clay loam to a depth of 60 inches or more.

Minor soils in this association are in the Enos, Ethete, Fruita, Griffy, Oceanet, Pavillion, Persayo, Saddle, Teapo, Wall, Winkleman, and Worland series. The Ethete soils are on terraces. The Griffy soils are on alluvial fans and terraces. The Persayo and Oceanet soils are on uplands. The Fruita, Teapo, Pavillion, and Worland soils are on uplands and foot slopes. Enos and Wall soils are in areas of wind-deposited sand. Winkleman soils are on valley fills. Saddle soils are on uplands. Wet alluvial land also is in this association.

This association is used mainly for irrigated crops and pasture, but it is also used for range. Some of the best range in the survey area is in this association. The better farms also are in this association. The major soils are suited to all crops commonly grown in the survey area. Some irrigated parts of the association are areas of concern because of topography and variable depth to bedrock. Many fields cannot be leveled without exposing bedrock.

A small number of pheasants live in the association in irrigated areas. These areas could support a large number of pheasants. Chukars also are present in small numbers. Ducks and geese inhabit areas around Pilot Butte Reservoir, Ocean Lake, small ponds and marshes, and along drainage ditches. The Ocean Lake shore is being developed for recreation.

2. Persayo-Oceanet Association

Shallow, nearly level to moderately steep sandy clay loams and sandy loams; on uplands

This association consists principally of shallow, well-drained soils on uplands. Slopes are 0 to 30 percent (fig. 3). These soils formed in weathered clay shale and sandstone of the Tertiary Wind River Formation. The association occurs as breaks along the Wind River. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free season is 120 to 140 days. Elevation ranges from 5,000 to 5,700 feet.

This association occupies about 12 percent of the survey area. Persayo soils make up about 50 percent of the association, Oceanet soils about 25 percent, and Rock land about 8 percent. Minor soils make up the remaining 17 percent.

Persayo soils are light olive-gray sandy clay loam underlain by clay shale at a depth of 10 to 20 inches. Oceanet soils are light yellowish-brown sandy loam underlain by sandstone at a depth of 10 to 20 inches.

Minor soils in this association are in the Worland, Pavillion, Saddle, Apron, and Lostwells series. The Worland and Pavillion soils are on uplands and foot slopes.

Figure 3.—**Part of the Persayo-Oceanet association looking northwest toward Water Tank Hill, west of Shoshoni. Persayo soils are on slopes in foreground. Oceanet soils occur with the sandstone ledges and Rock land.**

The Saddle soils are on uplands. The Apron and Lostwells soils are on alluvial fans.

This association is used mainly for range. Chukars live in some areas.

3. Ethete-Griffy Association

Deep, nearly level to sloping loams; on terraces

This association consists of deep, well-drained loams on terraces. Slopes are 0 to 10 percent (fig. 4). These soils formed in mixed alluvium, underlain by stratified sand and gravel. The principal area of this association is near Riverton. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free season is 110 to 140 days. Elevation ranges from 4,800 to 5,500 feet.

This association occupies about 7 percent of the survey area. Ethete soils make up about 35 percent of the association and Griffy soils about 30 percent. Minor soils make up the remaining 35 percent.

Ethete soils have a surface layer of light brownish-gray loam. The subsoil is brown to pale-brown clay loam. The upper part of the substratum is white gravelly clay loam, and the lower part is light brownish-gray very gravelly sand to a depth of 60 inches or more.

Griffy soils have a surface layer of light brownish-gray loam. The upper part of the subsoil is brown sandy clay loam, and the lower part is very pale brown fine sandy loam. The substratum is pale-yellow fine sandy loam to a depth of 60 inches or more.

Minor soils in this association are in the Clifterson, Saddle, Apron, and Lostwells series. Areas of Saline wet land and Wet alluvial land are also in this association.

This association is used about equally for irrigated crops, pasture, and range. Irrigated areas of Ethete soils are suited to all crops commonly grown in the survey area except dry beans. Griffy soils are suited to all crops commonly grown in the area.

Pheasants live in irrigated areas of this association, and chukars inhabit the range. Some recreational developments are along the shore of Boysen Reservoir. Riverton, the largest city of the area, is in this association. Most of the gravel pits of the Riverton Area are in this association.

Figure 4.—**Landscape in Ethete-Griffy association between Griffy Hill and Riverton. Griffy soils are at middle distance, and Ethete soils are in background.**

4. Tipperary-Trook Association

Deep, nearly level to moderately steep loamy sands and sandy loams; on terraces and alluvial fans

This association consists of deep, well-drained and somewhat excessively drained, loamy sands and sandy loams on old high terraces and alluvial fans (fig. 5). Slopes are 0 to 20 percent. These soils formed in sandy alluvium. The only area of this association is west of Boysen Reservoir in the northern part of the survey area. Precipitation is about nine inches, the average annual soil temperature is about 51° F., and the frost-free season is 120 to 140 days. Elevation ranges from 4,800 to 5,300 feet.

This association occupies about 6 percent of the survey area. Tipperary soils make up about 55 percent of the association and Trook soils about 25 percent. Minor soils make up the remaining 20 percent.

Tipperary soils have a surface layer of light brownish-gray loamy sand about 5 inches thick. The underlying material is light brownish-gray loamy sand to sand to a depth of 60 inches or more. Trook soils are pale-brown to white sandy loam or gravelly sandy loam to a depth of 60 inches or more.

Minor soils in this association are in the Meeteetse, Apron, and Clifterson series.

This association is used mainly for range, but a sizable area is irrigated. Trook soils are some of the better irrigated ones in the survey area and are suited to all commonly grown local crops. Tipperary soils are best maintained in permanent cover or close-growing crops.

This association now supports few pheasants, but it could be developed into excellent pheasant habitat. Areas of this association can be developed for recreation on the west shore of Boysen Reservoir and the shore of Lake Cameahwait.

5. Apron-Trook Association

Deep, nearly level to moderately steep sandy loams; on alluvial fans and terraces

This association consists of deep, well-drained sandy loams on alluvial fans and terraces (fig. 6). Slopes are 0 to 15 percent. These soils formed in alluvium washed from old high terraces and from weathered sandstone and clay shale. The principal area of this association is between Fivemile and Muddy Creeks. Annual precipita-

Figure 5.—**Part of the Tipperary-Trook association. Soil in foreground is Tipperary. The Bridger Mountains in the background are out of survey area.**

tion is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free season is 120 to 140 days. Elevation ranges from 4,800 to 5,300 feet.

This association occupies about 22 percent of the survey area. Apron soils make up about 30 percent of the association and Trook soils about 20 percent. Minor soils make up the remaining 50 percent.

Apron soils are light brownish-gray to light yellowish-brown sandy loam to a depth of 60 inches or more. Trook soils are pale-brown to white sandy loam or gravelly sandy loam to a depth of 60 inches or more.

Minor soils in this association are in the Lostwells, Worland, Pavillion, Enos, Persayo, Oceanet, Clifterson, Fruita, Birdsley, and Boysen series. Areas of Rock land also are in this association.

This association is used mainly for range. Irrigated areas, however, are suited to all crops commonly grown in the survey area. A few pheasants live in the irrigated part of this association, but the area could be developed as an excellent habitat. Some chukars inhabit the rough areas. Some recreational developments are along the shore of Boysen Reservoir.

6. Crowheart-Bigwin Association

Deep, nearly level loams and fine sandy loams; on flood plains

This association consists of nearly level, somewhat poorly drained loams and fine sandy loams that are underlain by sand and gravel (fig. 7). Some of the soils are affected by salt. Slopes are 0 to 3 percent. These soils formed in mixed alluvium. This association extends along the Wind River. Annual precipitation is about 9 inches, the average annual soil temperature is about 50° F., and the frost-free season is 110 to 140 days. Elevation ranges from 4,600 to 5,500 feet.

This association occupies about 3 percent of the survey area. Crowheart soils make up about 45 percent of the association and Bigwin soils about 30 percent. Minor soils make up the remaining 25 percent.

Crowheart soils have a surface layer of mottled, light brownish-gray loam. The subsoil is mottled, light brownish-gray fine sandy loam. It is stratified with thin lenses of loam. The substratum is stratified sand and gravel to a depth of 60 inches or more. The soils are slightly saline.

Bigwin soils have a surface layer of light brownish-gray fine sandy loam. The subsoil is light brownish-gray fine sandy loam. It is stratified with lenses of loam and clay loam. The substratum is stratified sand and gravel to a depth of 60 inches or more. A seasonal high water table is at a depth of 3 to 5 feet in these soils.

Minor soils in this association are in the Glenton and Winkleman series, and the gravel substratum phase of the Effington series. Areas of Marsh, Saline wet land, and Wet alluvial land are also in this association.

This association is used principally for range. Much of the area of this association is covered by trees and

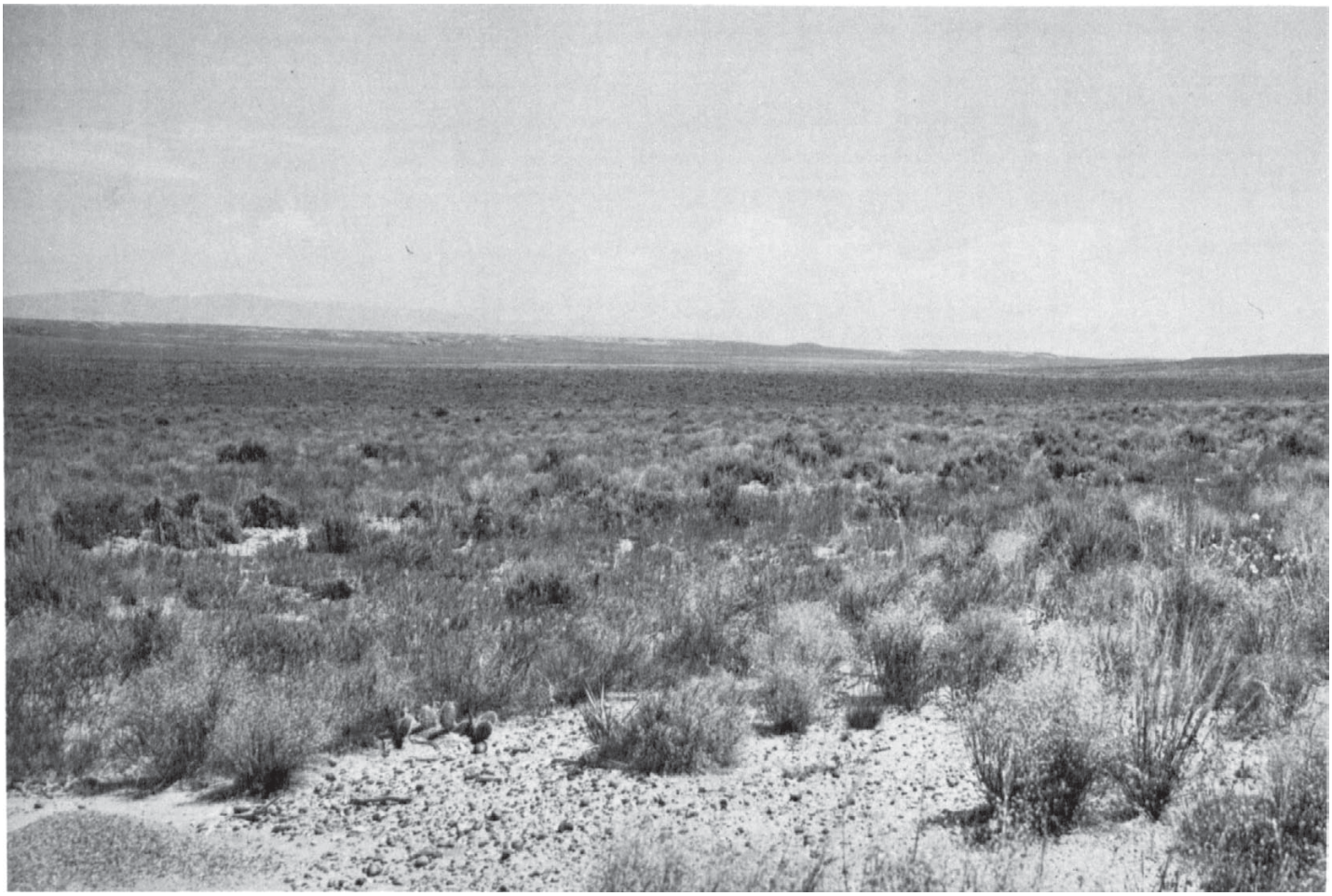

Figure 6.—**Part of the Apron-Trook association looking to the northeast across Muddy Ridge. Apron soils are in foreground.**

shrubs. Irrigated areas are used mainly for hay and pasture.

Mule deer live in areas of this association, but other wildlife are seldom present. Several picnic areas have been developed in this association.

7. Fivemile-Binton Association

Deep, nearly level to gently sloping silty clay loams; on flood plains and low terraces

This association consists of deep, well-drained silty clay loams (fig. 8) on flood plains and low terraces. Slopes are 0 to 6 percent. These soils formed in mixed alluvium from the red beds of the Circle Ridge area. The principal area of this association is along Fivemile Creek. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free season is 120 to 140 days. Elevation ranges from 4,800 to 5,500 feet.

This association occupies about 5 percent of the survey area. Fivemile soils make up about 55 percent of the association and Binton soils about 25 percent. Minor soils make up the remaining 20 percent.

Fivemile soils have a surface layer of light brownish-gray silty clay loam about 5 inches thick. The underlying material is grayish-brown silty clay loam. It is stratified with thin lenses of silt loam, loam, clay loam, and very fine sandy loam to a depth of 60 inches or more.

Binton soils have a surface layer of pale-brown, very strongly alkaline silty clay loam about 6 inches thick. The underlying material is pale-brown, very strongly alkaline silty clay loam. It has thin strata of loam, silt loam, and very fine sandy loam to a depth of 60 inches or more. The soils are slightly to strongly saline in places.

Minor soils in this association are in the Youngston, Lostwells, and Winkleman series. Areas of Gullied land also are in this association.

This association is used about equally for irrigated crops and pasture. Livestock is excluded from much of the area along Fivemile Creek as an erosion-control measure. The pheasant habitat is good along Fivemile Creek.

8. Birdsley-Effington-Boysen Association

Shallow to deep, nearly level to sloping alkali clay loams and sandy clay loams; on alluvial fans and uplands

This association consists of shallow to deep, well-drained clay loams and sandy clay loams on alluvial fans and uplands (fig. 9). Very strong alkaline reaction (alkali) is the outstanding feature of the soils in this association. Slopes are 0 to 10 percent. These soils formed

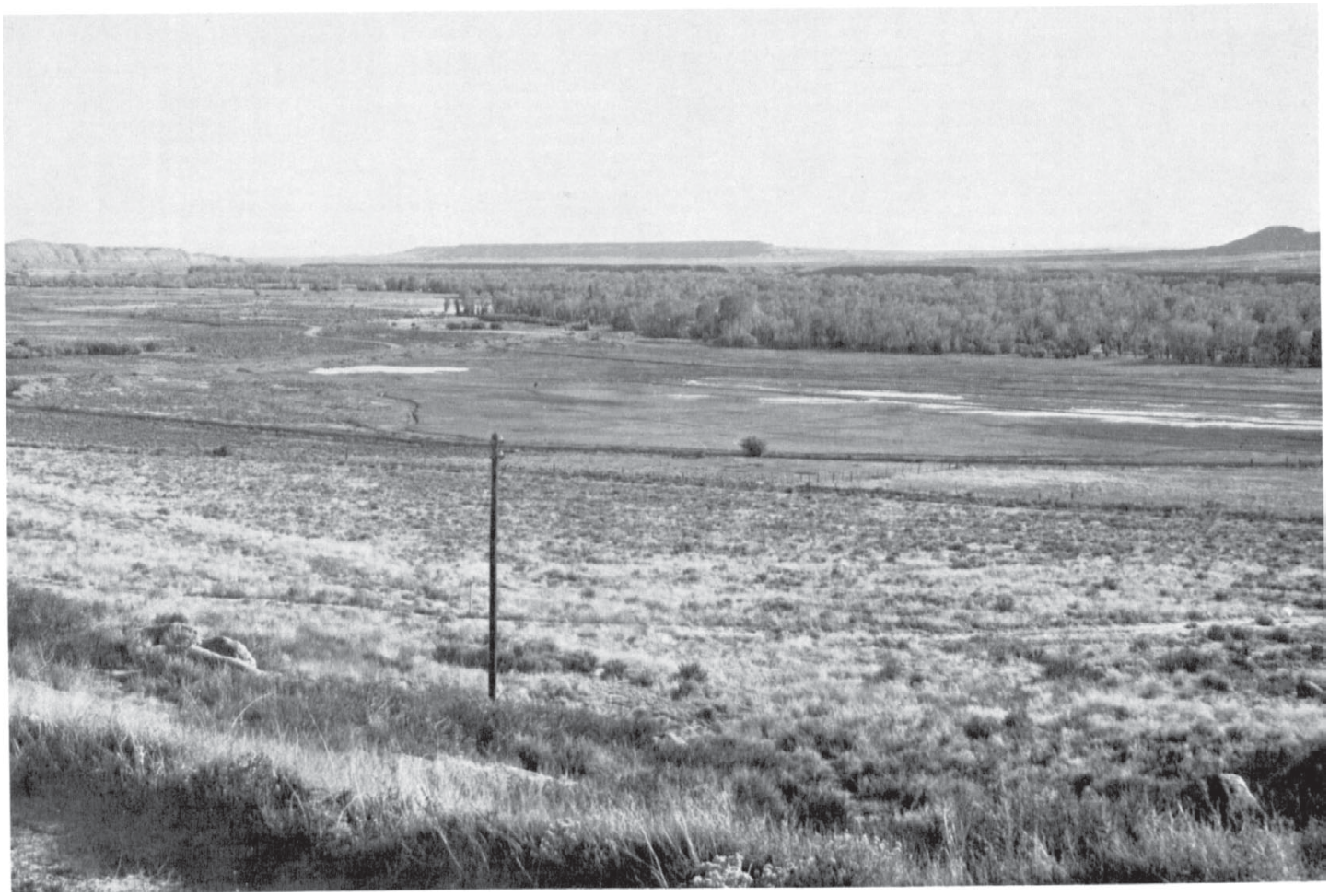

Figure 7.—**Part of the Crowheart-Bigwin association in Kinnear Valley. Effington, gravel substratum, soils are on the irrigated flat, and Crowheart and Bigwin soils are in areas of trees.**

in alluvium and residuum. The two areas of this association are on the east side of Ocean Lake and on Muddy Ridge. The association is underlain by clay shale and sandstone of the Tertiary Wind River Formation. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free season is 120 to 140 days. Elevation ranges from 5,000 to 5,500 feet.

This association occupies about 7 percent of the survey area. Bridsley soils make up about 25 percent of the association, Effington soils about 20 percent, and Boysen soils about 10 percent. Minor soils make up the remaining 45 percent.

Birdsley soils are pinkish-gray to brown, very strongly alkaline clay loam. They are underlain, at a depth of 10 to 20 inches, by clay shale. The Birdsley soils are on uplands.

Effington soils have a surface layer of light brownish-gray, strongly alkaline sandy clay loam about 5 inches thick. The subsoil is grayish-brown to light brownish-gray, very strongly alkaline clay. Salt has accumulated in the lower part. The substratum is light brownish-gray, very strongly alkaline sandy clay loam. It is stratified with thin lenses of clay loam, loam, and sandy loam to a depth of 60 inches or more. Effington soils are on alluvial fans.

Boysen soils are light-brown to pinkish-gray or pale-yellow, very strongly alkaline sandy clay loam to a depth of 60 inches or more. They are on alluvial fans and in playas.

Minor soils in this association are in the Meeteetse, Fruita, Pavillion, Mudray, Lostwells, and Persayo series.

This association is used for range. It is poor habitat for wildlife.

Descriptions of the Soils

This section describes the soil series and mapping units in the survey 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, that is, the sequence of layers from the surface downward to rock or other underlying material.

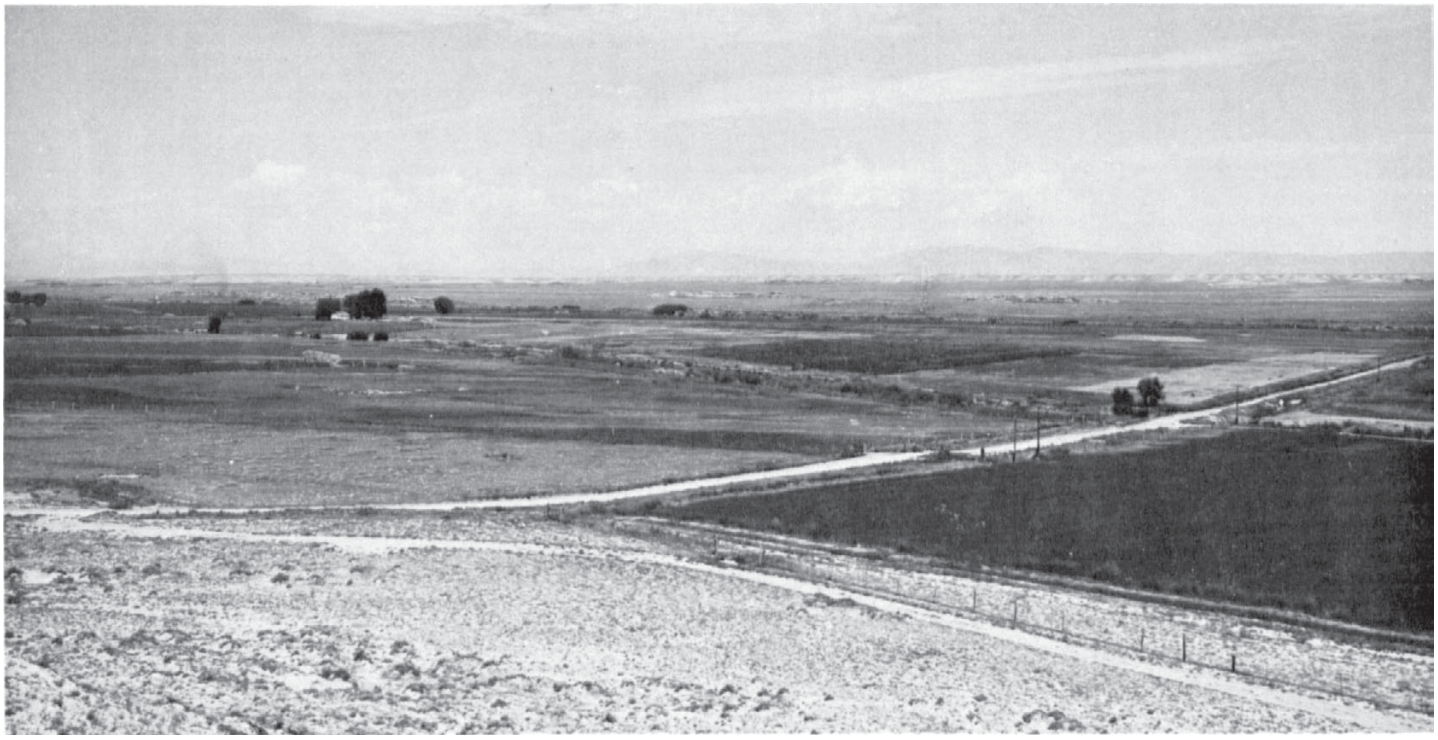

Figure 8.—Part of the Fivemile-Binton association. The cultivated areas are Fivemile soils.

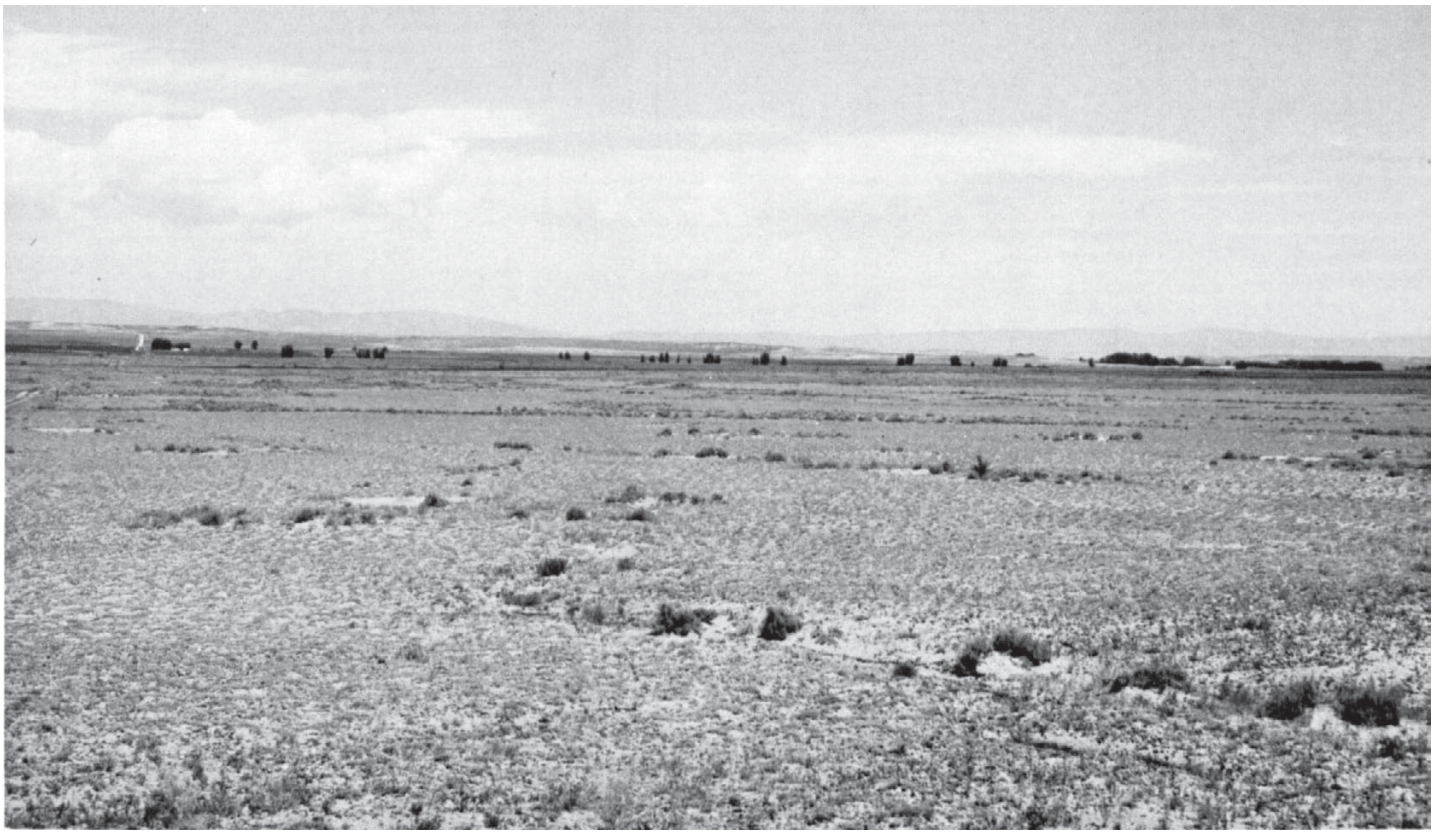

Figure 9.—Part of the Birdsley-Effington-Boysen association on the east side of Ocean Lake. View is to the north. Birdsley soils are in the foreground, and Effington soils are where the vegetation is taller.

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. The profile described in the series is representative for mapping units in that series. This profile is part of the description of the first soil described in the series and is in the series description. 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. Color terms are for dry soil unless otherwise stated. Reaction (pH) is for a dilution of about one part soil to five parts indicator solution.

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

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

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the teminology and methods of soil mapping can be obtained from the Soil Survey Manual (*8*).

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

Soil	Acres	Percent
Apron sandy loam, 0 to 3 percent slopes	11, 835	3. 2
Apron sandy loam, 3 to 6 percent slopes	23, 959	6. 5
Apron sandy loam, 6 to 10 percent slopes	2, 961	. 8
Apron sandy loam, alkali, 0 to 6 percent slopes	383	. 1
Apron sandy loam, alkali substratum, 0 to 6 percent slopes	645	. 2
Apron sandy loam, saline, 0 to 6 percent slopes	2, 493	. 7
Apron sandy loam, wet, 0 to 6 percent slopes	421	. 1
Bigwin sandy loam	3, 551	. 9
Binton silty clay loam	4, 007	1. 1
Binton silty clay loam, saline	2, 150	. 6
Birdsley clay loam, 0 to 10 percent slopes	6, 488	1. 7
Birdsley-Boysen complex, 0 to 10 percent slopes	3, 625	1. 0
Birdsley-Pavillion association, sloping	2, 821	. 8
Boysen sandy clay loam, 0 to 6 percent slopes	2, 788	. 7
Clifterson gravelly loam, 10 to 30 percent slopes	2, 042	. 5
Clifterson association, hilly	2, 470	. 7
Clifterson-Rock land association, steep	8, 679	2. 3
Crowheart loam	4, 847	1. 3
Effington sandy clay loam	5, 264	1. 4
Effington sandy clay loam, gravel substratum	886	. 2
Effington sandy clay loam, wet	464	. 1
Effington-Apron association	435	. 1
Enos-Wall association, gently sloping	2, 086	. 6
Ethete loam, 0 to 3 percent slopes	6, 609	1. 8
Ethete loam, 3 to 6 percent slopes	480	. 1
Ethete loam, saline, 0 to 6 percent slopes	1, 563	. 4
Fivemile sandy clay loam, 0 to 3 percent slopes	768	. 2
Fivemile silty clay loam, 0 to 3 percent slopes	9, 561	2. 5
Fivemile silty clay loam, 3 to 6 percent slopes	353	. 1
Fivemile silty clay loam, saline, 0 to 6 percent slopes	1, 015	. 3
Fruita clay loam, 0 to 3 percent slopes	2, 569	. 7
Fruita clay loam, 3 to 6 percent slopes	1, 992	. 5
Glenton sandy loam	1, 204	. 3
Griffy loam, 0 to 3 percent slopes	9, 847	2. 6
Griffy loam, 3 to 6 percent slopes	4, 334	1. 1
Griffy loam, 6 to 10 percent slopes	609	. 2
Gullied land	2, 119	. 6
Lostwells sandy clay loam, 0 to 3 percent slopes	24, 426	6. 6
Lostwells sandy clay loam, 3 to 6 percent slopes	5, 660	1. 5
Lostwells sandy clay loam, 6 to 10 percent slopes	329	. 1
Lostwells sandy clay loam, alkali, 0 to 6 percent slopes	954	. 3
Lostwells sandy clay loam, saline, 0 to 6 percent slopes	8, 106	2. 2
Marsh	533	. 1
Meeteetse loamy sand, 0 to 6 percent slopes	808	. 2
Meeteetse soils, 0 to 6 percent slopes	10, 221	2. 7
Mudray-Meeteetse loamy sands, 0 to 6 percent slopes	587	0. 2
Mudray-Meeteetse sandy clay loams, 0 to 6 percent slopes	1, 526	. 4
Oceanet sandy loam, 0 to 10 percent slopes	2, 717	. 7
Oceanet-Rock land association, hilly	2, 187	. 6
Pavillion sandy clay loam, 0 to 3 percent slopes	1, 911	. 5
Pavillion sandy clay loam, 3 to 10 percent slopes	4, 664	1. 2
Pavillion sandy clay loam, alkali, 0 to 6 percent slopes	1, 424	. 4
Persayo sandy clay loam, 0 to 30 percent slopes	18, 961	5. 0
Persayo-Oceanet association, steep	18, 447	4. 9
Persayo-Worland association, hilly	3, 579	. 9
Rock land	3, 529	. 9
Saddle sandy clay loam, 0 to 3 percent slopes	1, 089	. 3
Saddle sandy clay loam, 3 to 10 percent slopes	4, 335	1. 1
Saline wet land	7, 735	2. 0
Teapo sandy clay loam, 0 to 3 percent slopes	634	. 2
Teapo sandy clay loam, 3 to 6 percent slopes	971	. 3
Teapo sandy clay loam, saline, 0 to 6 percent slopes	692	. 2
Tipperary loamy sand, 0 to 6 percent slopes	16, 206	4. 3
Tipperary loamy sand, 6 to 10 percent slopes	2, 688	. 7
Tipperary loamy sand, alkali, hummocky	1, 529	. 4
Tipperary-Tipper association, hilly	3, 860	1. 0
Tipperary-Trook association, hilly	1, 625	. 4
Trook sandy loam, 0 to 3 percent slopes	4, 677	1. 2
Trook sandy loam, 3 to 6 percent slopes	1, 975	. 5
Trook sandy loam, 6 to 10 percent slopes	269	. 1
Trook sandy loam, saline, 0 to 6 percent slopes	332	. 1
Trook-Apron association, gently sloping	19, 529	5. 2
Trook-Clifterson association, moderately steep	7, 757	2. 1
Wet alluvial land	2, 825	. 8
Winkleman silty clay	2, 659	. 7
Winkleman silty clay, saline	1, 979	. 5
Winkleman silty clay, wet	406	. 1
Worland sandy loam, 0 to 3 percent slopes	1, 436	. 4
Worland sandy loam, 3 to 6 percent slopes	4, 105	1. 1
Worland sandy loam, 6 to 10 percent slopes	778	. 2
Worland sandy loam, saline, 0 to 6 percent slopes	414	. 1
Worland-Oceanet complex, 0 to 10 percent slopes	6, 936	1. 8
Youngston clay loam	1, 427	. 4
Gravel pits	222	. 1
Water	27, 450	7. 3
Total	375, 432	100. 0

Apron Series

The Apron series consists of well-drained sandy loams that formed in mixed materials on alluvial fans. These soils are throughout the survey area. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, needle-and-thread, Indian ricegrass, and blue grama.

In a representative profile the surface layer is light brownish-gray sandy loam about 6 inches thick. It is underlain by light yellowish-brown sandy loam that extends to a depth of 60 inches or more. The soil is moderately alkaline and calcareous throughout.

Apron soils are associated with Lostwells and Worland soils.

Apron sandy loam, 3 to 6 percent slopes (ApB).—This gently sloping soil is on alluvial fans. The surface is generally smooth.

Representative profile in a grain field, 264 feet west and 129 feet south of center of sec. 30, T. 2 N., R. 5 E. (fig. 10) :

A—0 to 6 inches, light brownish-gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate, fine, granular structure; soft, very friable; few pebbles; calcareous; moderately alkaline (pH 8.2) ; gradual, smooth boundary.

C—6 to 60 inches, light yellowish-brown (2.5Y 6/3) sandy loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable; few pebbles; calcareous; moderately alkaline (pH 8.4).

Color of the A horizon ranges from 2.5Y to 5Y in hue, from 2 to 3 in chroma, and from 5 to 7 dry and from 4 to 5 moist in value. Reaction of the A horizon ranges from 8.0 to 8.5 and that of the C horizon from 8.2 to 8.7.

Included with this soil in mapping are small areas of Lostwells sandy clay loam, Trook sandy loam, Worland sandy loam, and Tipperary loamy sand.

Permeability is moderately rapid in this Apron soil, and runoff is medium. Available water capacity is 6 to 7.5 inches. Roots can penetrate to a depth of 60 inches or more. The hazards of wind and water erosion are moderate.

This soil is used for irrigated crops and pasture, range, windbreaks, and community and recreational purposes, and as wildlife habitat. In irrigated areas sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIe, dryland; capability unit IIIe–5, irrigated; Sandy range site.

Apron sandy loam, 0 to 3 percent slopes (ApA).—Most of this soil is in the irrigated valleys. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

This soil is used similarly to Apron sandy loam, 3 to 6 percent slopes. Capability subclass VIe, dryland; capability unit IIe–5, irrigated; Sandy range site.

Apron sandy loam, 6 to 10 percent slopes (ApC).—This sloping soil is on coalescing alluvial fans and along drainageways that dissect alluvial fans. Included in mapping are about 100 acres of Apron sandy loam, 10 to 15 percent slopes. Runoff is medium, and the hazard of water erosion is moderate to severe.

Irrigated pasture and range are the major uses. Alfalfa and small grains are grown in irrigated areas. Capability subclass VIe, dryland; capability unit IVe–5, irrigated; Sandy range site.

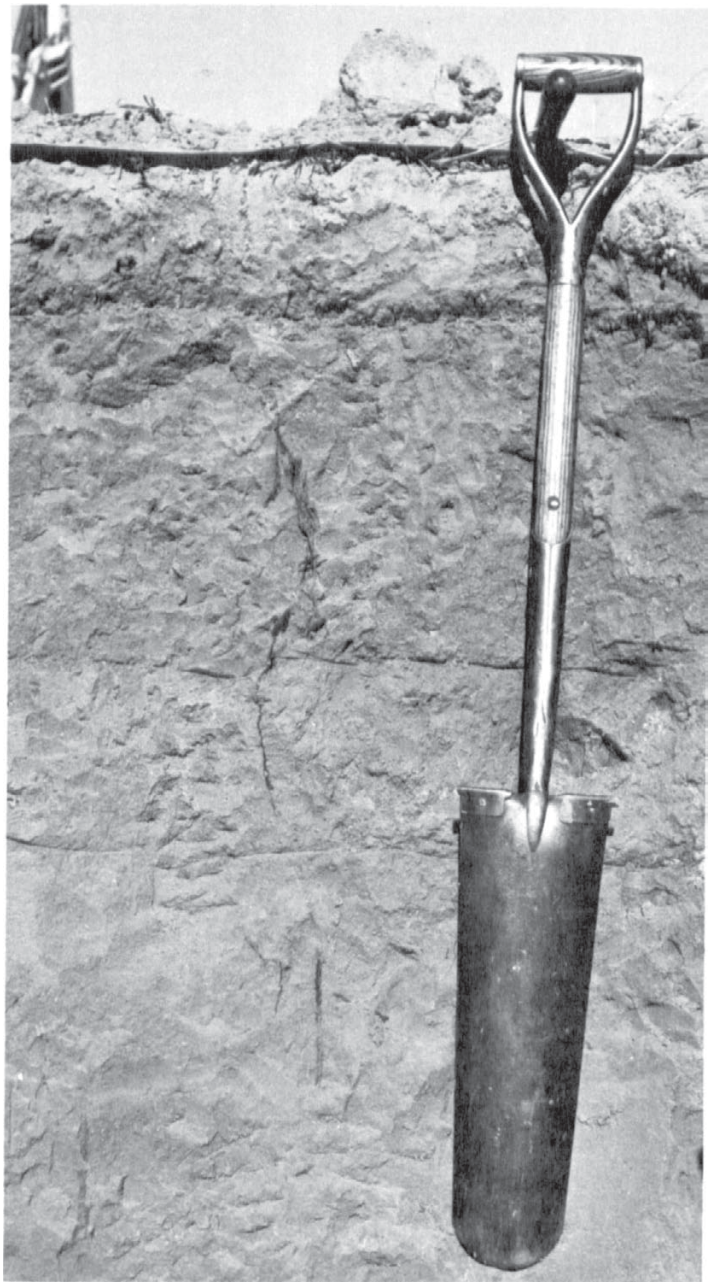

Figure 10.—**Profile of Apron sandy loam, a deep soil.**

Apron sandy loam, alkali, 0 to 6 percent slopes (ArB).—This very alkaline soil has undulating to low, dunelike terrain. Otherwise it has a profile similar to that described for Apron sandy loam, 3 to 6 percent slopes. Slopes are generally about 5 percent. Greasewood is the principal vegetation. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Included with this soil in mapping are small areas of Apron sandy loam, 3 to 6 percent slopes, and Tipperary loamy sand, alkali, hummocky.

This soil is used for range and as wildlife habitat.

Capability subclass VIIs, dryland; Saline Lowland range site.

Apron sandy loam, alkali substratum, 0 to 6 percent slopes (AsB).—This nearly level to gently sloping soil differs from Apron sandy loam, 3 to 6 percent slopes, in having a very alkaline, sandy clay loam substratum at a depth of 20 to 30 inches. Runoff is slow to medium. The hazard of water erosion is slight to moderate.

Included with this soil in mapping are small areas of Apron sandy loam, Fruita clay loam, Effington sandy clay loam, and Meeteetse loamy sand and sandy clay loam.

This soil is used for range and as wildlife habitat. If this soil is irrigated, the upper 20 to 30 inches rapidly become very strongly alkaline. Capability subclass VIe, dryland; Sandy range site.

Apron sandy loam, saline, 0 to 6 percent slopes (AtB).—This slightly saline soil is somewhat poorly drained. The water table is at a depth of 2 to 4 feet. The salinity and drainage problems are the result of excess irrigation. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Included with this soil in mapping are small areas of Saline wet land; Wet alluvial land; Lostwells sandy clay loam, saline; and Apron sandy loam, wet.

This soil is used mostly for irrigated pasture. It is also used for irrigated crops, range, recreational purposes, and as wildlife habitat. Sugar beets and small grains are grown in irrigated areas. Special onsite investigation is needed to determine if these soils can be reclaimed. Until reclamation can be accomplished, only plants of moderate salt tolerance, such as alkali sacaton, inland saltgrass, and western wheatgrass, will thrive. Capability subclass VIws, dryland; capability unit IIIws–10, irrigated; Saline Subirrigated range site.

Apron sandy loam, wet, 0 to 6 percent slopes (AuB).—This poorly drained soil has a saline water table at or near the surface during most of the growing season. The water table is at a depth of 0 to 1 foot. The soil material has iron stains, but it is not gleyed. During seasons when the water table drops, there may be patches of salt crust on the surface. Cattails, sedges, and rushes are the dominant vegetation.

Included with this soil in mapping are small areas of Saline wet land; Wet alluvial land; and Apron sandy loam, saline.

This soil is used for range and as wildlife habitat. Special onsite investigations are needed to determine if this soil can be drained. Capability subclass VIw, dryland; Wetland range site.

Bigwin Series

The Bigwin series consists of somewhat poorly drained sandy loams that are underlain by sand and gravel at a depth of 20 to 40 inches. Bigwin soils are along the Big Wind River. They occupy channeled bottom lands and are nearly level. Elevation ranges from 4,600 to 5,500 feet. Annual precipitation is about 9 inches, the average annual soil temperature is about 50° F., and the frost-free period is 110 to 140 days. The dominant vegetation is cottonwoods, willows, rose bushes, big sagebrush, and little bluestem.

In a representative profile the surface layer is light brownish-gray fine sandy loam about 5 inches thick. The subsoil is light brownish-gray fine sandy loam. It has stratified lenses of loam and clay loam and dark-brown mottles. The substratum is stratified sand and gravel to a depth of 60 inches or more. Bigwin soils are moderately alkaline and calcareous.

Bigwin soils are associated with Crowheart soils.

Bigwin sandy loam (Bg).—This nearly level soil is dissected by stream channels.

Representative profile in the Diversion Dam picnic grounds, about 200 feet east and 100 feet north of the west quarter corner of sec. 24, T. 3 N., R. 2 W.:

A1—0 to 5 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; calcareous; moderately alkaline (pH 8.2); gradual, smooth boundary.

B2g—5 to 30 inches, light brownish-gray (10YR 6/2) fine sandy loam stratified with lenses of loam and clay loam, dark grayish brown (10YR 4/2) moist; common, distinct, medium, dark-brown (10YR 4/3) mottles moist; massive; slightly hard, very friable; calcareous; moderately alkaline (pH 8.2); clear, wavy boundary.

IIC—30 to 60 inches, stratified sand and gravel; calcareous; some cobblestones.

The depth to the sand and gravel substratum ranges from 20 to 40 inches. The A and B horizons are as much as 10 percent gravel in places. This soil has a water table that fluctuates between depths of 3 and 5 feet during the growing season.

Included with this soil in mapping are small areas of Crowheart loam, Wet alluvial land, and Apron sandy loam, 6 to 10 percent slopes. The Apron soil occurs as low dunes.

Permeability is moderately rapid in this Bigwin soil, and runoff is slow. The available water capacity is 5 to 7 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

This soil is used mostly for wooded pasture. A small acreage is in irrigated pasture. Picnic areas and campgrounds have been developed in places. Some areas of this soil provide good habitat for deer. Capability subclass VIw, dryland; capability unit IIIw–63, irrigated; Lowland range site.

Binton Series

The Binton series consists of well-drained silty clay loams. These are alkaline soils that formed in stratified mixed alluvium. These soils are along Fivemile and Muddy Creeks and at the Pilot Butte oil field. They occupy nearly level terraces and flood plains. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, the average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is greasewood and Gardner saltbush.

In a representative profile the surface layer is pale-brown silty clay loam about 6 inches thick. It is underlain by pale-brown silty clay loam with thin strata of loam, silt loam, and very fine sandy loam to a depth of 60 inches or more. The soil is very strongly alkaline and calcareous throughout.

Binton soils are associated with Fivemile soils.

Binton silty clay loam (Bm).—This soil occupies nearly level terraces and flood plains.

Representative profile in a native pasture NW¼SE¼ of sec. 13, T. 3 N., R. 1 W.:

A1—0 to 6 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, fine, granular structure; soft, very friable; calcareous; very strongly alkaline (pH 9.2); clear, smooth boundary.

C—6 to 60 inches, pale-brown (10YR 6/3) silty clay loam stratified with lenses of loam, silt loam, and very fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; accumulation of calcium carbonate and calcium sulfate as concretions and seams; calcareous, very strongly alkaline (pH 9.2).

Hue ranges from 10YR to 7.5YR throughout the profile. Reaction ranges from 8.5 to 9.6 between strata, but it is dominantly 9.1 or more to a depth of 40 inches. The soil contains a few pebbles in places.

Included with this soil in mapping are small areas of Fivemile silty clay loam.

Permeability is slow in this Binton soil, and runoff is medium. Available water capacity is 4 to 5 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of erosion is slight.

This soil is used for range and as wildlife habitat. Capability subclass VIIs, dryland; Saline Lowland range site.

Binton silty clay loam, saline (Bn).—This strongly saline soil is along deeply entrenched drainageways. Included with this soil in mapping are small areas of Binton silty clay loam and Boysen sandy clay loam.

This soil is used for range and as wildlife habitat. Capability subclass VIIs dryland; Saline Lowland range site.

Birdsley Series

The Birdsley series consists of well-drained clay loams. They are underlain by interbedded clay shale and sandstone at a depth of 10 to 20 inches. These soils are mainly along Eight Mile Road and on Muddy Ridge, but they also are present throughout much of the survey area. They occupy uplands. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is birdfoot sagebrush, Indian ricegrass, and woody aster.

In a representative profile the surface layer is pinkish-gray clay loam about 1 inch thick. The underlying material is brown clay loam to a depth of 12 inches and is clay shale below that depth. This is very strongly alkaline and strongly calcareous.

Birdsley soils are associated with Boysen and Mudray soils.

Birdsley clay loam, 0 to 10 percent slopes (BoC).—This soil is on uplands. It has a rilled surface.

Representative profile in native range, about 0.1 mile west and 350 feet south of the NE corner of sec. 11, T. 3 N., R. 3 E.:

A1—0 to 1 inch, pinkish-gray (7.5YR 6/2) clay loam, brown (7.5YR 4/2) moist; strong, very fine, granular structure; hard, firm, sticky and plastic; many pebbles on surface, few pebbles below; strongly calcareous; very strongly alkaline (pH 9.2); abrupt, smooth boundary.

C1—1 to 12 inches, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) moist; massive; extremely hard, very firm, sticky and plastic; few fine salt segregations; strongly calcareous; very strongly alkaline (pH 9.4); abrupt, wavy boundary.

IIC2—12 inches, greenish-gray, platy, calcareous clay shale; very strongly alkaline.

This soil ranges from 7.5YR to 2.5Y in hue. The C horizon is clay loam, silty clay loam, or sandy clay loam. Reaction is 9.2 or more throughout. Bedrock is at a depth of 10 to 20 inches.

Included with this soil in mapping are small areas of Boysen sandy clay loam, Mudray sandy clay loam, Meeteetse sandy clay loam, and Effington sandy clay loam.

Permeability is very slow in this Birdsley soil, and runoff is medium to rapid. Available water capacity is 1 to 3 inches. Roots can penetrate to a depth of 10 to 20 inches. The hazard of water erosion is moderate to severe, and the hazard of wind erosion is slight.

This soil is used for range and as wildlife habitat. Capability subclass VIIs, dryland; Alkali Uplands range site.

Birdsley-Boysen complex, 0 to 10 percent slopes (BRC).—This complex occupies foot slopes in the northern part of the survey area. About 70 percent of the complex is Birdsley clay loam and Boysen sandy clay loam in approximately equal parts.

Included with this complex in mapping are Meeteetse sandy clay loam and Pavillion sandy clay loam. The Meeteetse soil makes up about 20 percent of the complex and the Pavillion soil about 10 percent. Also included are small areas of Mudray sandy clay loam and Effington sandy clay loam.

This complex is used for range and as wildlife habitat. Capability subclass VIIs, dryland. Birdsley clay loam, Boysen sandy clay loam, and Meeteetse sandy clay loam are in the Alkali Uplands range site. Pavillion sandy clay loam, alkali, is in the Saline Upland range site.

Birdsley-Pavillion association, sloping (BSC).—This nearly level to sloping association is on uplands. Slopes are 0 to 10 percent. This mapping unit consists of about 60 percent Birdsley clay loam and 30 percent Pavillion sandy clay loam. Included in mapping, and making up about 10 percent of the mapped areas, are areas of Apron sandy loam. Also included are small areas of Persayo sandy clay loam, Teapo sandy clay loam, and Fruita clay loam.

This association is used for range and as wildlife habitat. Capability subclass VIIs, dryland; Birdsley clay loam is in the Alkali Uplands range site, and Pavillion sandy clay loam is in the Loamy range site. Apron sandy loam is in the Sandy range site.

Boysen Series

The Boysen series consists of well-drained sandy clay loams on alluvial fans and in playas. These soils are principally on Muddy Ridge but are also present throughout much of the area. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation

is birdfoot sagebrush, Indian ricegrass, and woody aster.

In a representative profile the surface layer is light-brown sandy clay loam about 3 inches thick. The underlying material is pinkish-gray to pale-yellow sandy clay loam stratified with lenses of clay loam, loam, and clay to a depth of 60 inches or more. The soil is very strongly alkaline and strongly calcareous throughout.

Boysen soils are associated with Birdsley soils.

Boysen sandy clay loam, 0 to 6 percent slopes (ByB).—This level to gently sloping soil occupies alluvial fans and playas. It has a rilled surface that has coppice mounds.

Representative profile in native range, about 675 feet south and 1,700 feet east of the northwest corner of sec. 18, T. 3 N., R. 4 E.:

A1—0 to 3 inches, light-brown (7.5YR 6/3) sandy clay loam, brown (7.5YR 5/2) moist; strong, very fine, granular structure; very hard, firm, sticky and plastic; pebbles on surface and throughout; strongly calcareous; very strongly alkaline (pH 9.2); abrupt, smooth boundary.

C—3 to 60 inches, pinkish-gray (7.5YR 6/2) to pale-yellow (2.5Y 7/4) sandy clay loam stratified with lenses of clay loam, loam, and clay; brown (7.5YR 5/2) to light yellowish brown (2.5Y 6/4) moist; massive; very hard to extremely hard, firm, sticky and plastic; thin lenses of coarse sand; few pebbles throughout; strongly calcareous; very strongly alkaline (pH 9.4).

The soil ranges in clay content from 20 to 35 percent. The soil reaction is pH 9.1 or greater throughout.

Included with this soil in mapping are small areas of Birdsley clay loam, Mudray sandy clay loam, Meeteetse sandy clay loam, and Effington sandy clay loam.

Permeability is very slow in this Boysen soil, and runoff is slow to rapid. Available water capacity is 4 to 5 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of water erosion is slight to moderate, and the hazard of wind erosion is moderate.

This soil is used for range and as wildlife habitat. Capability subclass VIIs, dryland; Alkali Uplands range site.

Clifterson Series

The Clifterson series consists of somewhat excessively drained gravelly loams. They formed in mixed material. These soils are mainly along the Big Wind River on the high outwash terrace known as Cottonwood Bench and on alluvial fans on the east side of Boysen Reservoir. They are also in scattered tracts on high terraces throughout the survey area. Elevation ranges from 4,500 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, blue grama, and threadleaf sedge.

In a representative profile the surface layer is pale-brown gravelly loam about 3 inches thick. The underlying material is light yellowish-brown very gravelly loam to a depth of 60 inches or more. The soils are moderately alkaline and strongly calcareous throughout.

Clifterson gravelly loam, 10 to 30 percent slopes (CgE).—This moderately steep soil is on terrace breaks. It has a rilled surface.

Representative profile in native range, SE¼SE¼ of sec. 6, T. 2 N., R. 4 E.:

A1—0 to 3 inches, pale-brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; moderate, very fine, granular structure; hard, friable; 20 percent gravel; underside of pebbles is carbonate encrusted; strongly calcareous; moderately alkaline (pH 8.3); gradual, wavy boundary.

C—3 to 60 inches, light yellowish-brown (10YR 6/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; single grained; loose; 50 to 70 percent gravel and cobblestones; underside of pebbles and cobblestones carbonate encrusted; strongly calcareous; moderately alkaline (pH 8.4).

Hue ranges from 7.5YR to 2.5Y throughout the profile.

Included with this soil in mapping are small areas of Ethete loam, Persayo sandy clay loam, and Oceanet sandy loam.

Permeability is moderately rapid in this Clifterson soil, and runoff is rapid. Available water capacity is 3 to 5 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

This soil is used for range and as wildlife habitat. In addition, it is a good source of gravel. Chukars and sage chickens are the principal wildlife. Capability subclass VIe, dryland; Gravelly range site.

Clifterson association, hilly (CHE).—This association is on coalescing alluvial fans in the northeastern part of the survey area. Slopes are 3 to 30 percent. Many drainageways dissect the areas. This mapping unit is 75 percent Clifterson soils that have a channery surface layer. The profile of these soils is similar to that of Clifterson gravelly loam, 10 to 30 percent, but these soils contain channery fragments. The vegetation is juniper, big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass.

Included with these soils in mapping are small areas of Persayo sandy clay loam and Oceanet sandy loam. Also included are areas of Rock land.

This association is used for range and as wildlife habitat. Deer and antelope are the principal wildlife. Capability subclass VIe, dryland; Gravelly range site.

Clifterson-Rock land association, steep (CRF).—This steep to very steep association is on terrace escarpments and along entrenched drainageways that dissect terraces. This mapping unit consists of about 50 percent Clifterson gravelly loam, 25 percent Rock land, 15 percent Oceanet sandy loam, and 10 percent Persayo sandy clay loam. The Clifterson soil occupies the higher positions, and Rock land the lower positions.

Included with these soils in mapping are small areas of soils in the Ethete, Trook, Worland, and Apron series.

This association is used for range, as a source of gravel, and as habitat for wildlife, principally chukars. Clifterson gravelly loam is in capability subclass VIe, dryland; Gravelly range site. Rock land is in capability subclass VIIIs, dryland; range site not assigned. Oceanet sandy loam is in capability subclass VIIe, dryland; Shallow Sandy range site. Persayo sandy clay loam is in capability subclass VIIe, dryland; Shallow Clayey range site.

Crowheart Series

The Crowheart series consists of nearly level, somewhat poorly drained soils that are underlain by sand and gravel at a depth of 20 to 40 inches. These soils are along the Big Wind River on channeled flood plains. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is

about 9 inches, the average annual soil temperature is about 50° F., and the frost-free period is 110 to 130 days. The dominant vegetation is inland saltgrass, cottonwood, and willow.

In a representative profile the surface layer is light brownish-gray loam about 10 inches thick. It is slightly saline and very strongly alkaline. The subsoil, about 20 inches thick, is light brownish-gray fine sandy loam that is stratified with lenses of loam. The substratum is stratified sand and gravel to a depth of 60 inches or more. Salinity and alkalinity decrease with depth.

Crowheart soils are associated with Bigwin soils.

Crowheart loam (Cw).—This nearly level soil is on channeled flood plains.

Representative profile in a wooded pasture, about 1,190 feet west and 1,056 feet south of the NE. corner of sec. 4, T. 2 N., R. 1 E.:

A1sa—0 to 10 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; common, medium, distinct, dark-brown (10YR 4/3, 10YR 3/3 moist) mottles in the lower part of the horizon; moderate, fine, granular structure; soft, very friable; slightly saline, soft segregations of salt crystals; calcareous; very strongly alkaline (pH 9.2); gradual, smooth boundary.

B2g—10 to 30 inches, light brownish-gray (2.5Y 6/2) fine sandy loam stratified with lenses of loam, grayish brown (2.5Y 5/2) moist; common, coarse, distinct, dark-brown (10YR 4/3, 10YR 3/3 moist) mottles; massive; slightly hard, very friable; calcareous; moderately alkaline (pH 8.4); abrupt, wavy boundary.

IIC—30 to 60 inches, stratified sand and gravel; some cobblestones; calcareous.

In places areas of this soil have a salt crust on the surface. Conductivity of the A horizon ranges from 4 to 8 millimhos per centimeter and decreases with depth. Exchangeable sodium ranges from 15 to 30 percent in the surface layer, but it decreases with depth. The A and B horizons are 1 to 10 percent gravel. Depth to the sand and gravel substratum ranges from 20 to 40 inches.

Included with this soil in mapping are small areas of Bigwin sandy loam, Saline wet land, and Wet alluvial land.

Permeability is moderately rapid in this Crowheart soil, and runoff is slow. Available water capacity is 5 to 7 inches. If this soil is drained and reclaimed, roots can penetrate to a depth of 60 inches or more. The hazards of wind erosion and water erosion are slight. The water table is at a depth of 3 to 5 feet.

This soil is used for irrigated crops, pasture, range, windbreaks, recreational areas, and as wildlife habitat. Sugar beets and small grain are grown in irrigated areas. Pasture is the major use in irrigated areas, but the principal use of this soil is for wooded pasture. Picnic areas and campgrounds have been developed on this soil. Deer is the principal form of wildlife. Capability subclass VIws, dryland; capability unit IIIws–11, irrigated; Saline Subirrigated range site.

Effington Series

The Effington series consists of well-drained soils that have a clay subsoil. They formed in mixed material. These soils are mainly between Lost Wells Butte and Ocean Lake, but they are also throughout much of the survey area. They occupy nearly level alluvial fans and low terraces. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is about 120 to 140 days. The dominant vegetation is birdfoot sagebrush, Gardner saltbush, and Indian ricegrass.

In a representative profile the surface layer is light brownish-gray sandy clay loam about 5 inches thick. The subsoil is grayish-brown to light brownish-gray clay that has salt accumulations in the lower part. It is about 12 inches thick. The substratum is light brownish-gray, stratified sandy clay loam to a depth of 60 inches or more. The soil material is strongly to very strongly alkaline, moderately saline, and strongly calcareous throughout.

Effington soils are associated with Birdsley and Boysen soils.

Effington sandy clay loam (Ef).—This nearly level soil is on alluvial fans. It has a rilled surface that has coppice mounds.

Representative profile in a cultivated area, about 1,320 feet north and 220 feet east of the southwest corner of sec. 15, T. 2 N., R. 3 E.:

A1—0 to 5 inches, light brownish-gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; structureless massive to very weak, coarse, platy structure; very hard, friable, sticky and plastic; peds are very unstable in water; strongly calcareous; strongly alkaline (pH 8.9); clear, smooth boundary.

B2t—5 to 10 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; thin patchy clay films on ped surfaces; peds are moderately stable in water; strongly calcareous; very strongly alkaline (pH 9.2); gradual, smooth boundary.

B3sa—10 to 17 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; thin patchy clay films on all ped surfaces; salt accumulations in form of small, soft segregations and as finely divided coatings on peds; strongly calcareous; very strongly alkaline (pH 9.2); gradual, smooth boundary.

C—17 to 60 inches, light brownish-gray (2.5Y 6/2) sandy clay loam stratified with thin lenses of clay loam, loam, and sandy loam; dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; salt accumulations in form of soft segregations and as thin seams; strongly calcareous; very strongly alkaline (pH 9.3).

Hue ranges from 10YR to 5Y throughout the profile. In places small amounts of gravel are present throughout the profile.

Included with this soil in mapping are small areas of Boysen sandy clay loam, Winkleman silty clay, and Birdsley clay loam. Also included are about 150 acres of Effington sandy clay loam, 3 to 6 percent slopes.

Permeability is slow in this Effington soil, and runoff is slow to medium. Available water capacity is 4 to 5 inches. Roots can penetrate to a depth of 40 inches or more. The hazard of erosion is slight.

This soil is used for irrigated crops and pasture, range, and as wildlife habitat. Sugar beets, corn for silage, small grains, alfalfa, and pasture plants are grown in irrigated areas. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIs, dryland; capability unit IVs–12, irrigated; Alakali Uplands range site.

Effington sandy clay loam, gravel substratum (Eg).—This nearly level soil is on low terraces. It is underlain by stratified sand and gravel at a depth of 20 to 40 inches. Greasewood grows on this soil along with other vegetation.

Included with this soil in mapping are small areas of Crowheart loam, Bigwin sandy loam, Winkleman silty clay, Wet alluvial land, and Saline wet land. Also included are 32 acres of Effington sandy clay loam, gravel substratum, that has 3 to 6 percent slopes.

This soil is used for irrigated pasture and range. Capability subclass VIs, dryland; capability unit IVs–12, irrigated; Alkali Uplands range site.

Effington sandy clay loam, wet (En).—This nearly level soil is poorly drained and has a saline water table at or near the surface during much of the growing season. Depth to the water table ranges from 0 to 1 foot. The surface layer is moderately saline. In places it has iron stains but is not gleyed. During seasons when the water table drops, patches of salt crust form on the surface.

Included with this soil in mapping are small areas of Saline wet land, Wet alluvial land, and Effington sandy clay loam.

This soil is used for range and as wildlife habitat. Special onsite investigation is needed to determine whether this soil can be drained. Capability subclass VIw, dryland; Saline Subirrigated range site.

Effington-Apron association (EP).—This association is on alluvial fans in the west-central part of the survey area. The soils are nearly level. This mapping unit consists of about 60 percent Effington sandy clay loam and about 40 percent Apron sandy loam. Included in mapping are small areas of soils in the Fruita and Pavillion series.

This association is used for irrigated pasture and range. Range is the major use. Effington sandy clay loam is in capability subclass VIs, dryland; capability unit IVs–12, irrigated; Alkali Uplands range site. Apron sandy loam is in capability subclass VIe, dryland; capability unit IIe–5, irrigated; Sandy range site.

Enos Series

The Enos series consists of well-drained sandy loams that are underlain by sandstone at a depth of 20 to 40 inches. These soils are in the central part of the Area from Pilot Butte Reservoir to northeast of Riverton. They occupy gently sloping or hummocky uplands. Elevations are 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, Indian ricegrass, needle-and-thread, and blue grama.

In a representative profile the surface layer is light brownish-gray sandy loam about 4 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is pale-brown loamy sand about 14 inches thick. It is underlain by sandstone. The soil is neutral to moderately alkaline. The substratum is calcareous.

Enos soils are associated with Wall and Oceanet soils.

Enos-Wall association, gently sloping (ESB).—This mapping unit is on gently sloping to hummocky uplands. Slopes are 3 to 6 percent. It consists of about 40 percent Enos sandy loam, about 40 percent Wall loamy sand, about 8 percent Oceanet sandy loam, and about 8 percent Rock land. Included in mapping are small areas of Worland sandy loam, Apron sandy loam, Tipperary loamy sand, and Persayo sandy clay loam.

Representative profile in native range, 640 feet west and 550 feet south of the northeast corner of sec. 34, T. 3 N., R. 1 E. (fig. 11):

A1—0 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, very friable; neutral (pH 7.2); gradual, smooth boundary.

B2t—4 to 15 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; thin patchy clay films on all ped surfaces, clay bridging between sand grains, clay coatings on sand grains; mildly alkaline (pH 7.4); gradual, smooth boundary.

B3—15 to 20 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; mildly alkaline (pH 7.6); gradual, wavy boundary.

C1ca—20 to 34 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; single grained; loose; secondary calcium carbonate present as soft concretions and in thin seams and streaks; calcareous; moderately alkaline (pH 8.2); abrupt, wavy boundary.

IIC2—34 inches, calcareous, soft sandstone bedrock.

Sandstone is at a depth of 20 to 40 inches. Small amounts of gravel are present in some profiles.

Permeability is moderately rapid in this Enos soil, and runoff is slow to medium. Available water capacity is 3 to 5 inches. Roots can penetrate to a depth of 20 to 40 inches. The hazards of water and wind erosion are moderate.

This association is used for alfalfa, irrigated pasture, range, and windbreaks, and as wildlife habitat. Enos sandy loam is in capability subclass VIe, dryland; capability unit IVe–5, irrigated; Sandy range site. Wall loamy sand is in capability subclass VIe, dryland; capability unit IVe—4, irrigated; Sandy range site. Oceanet sandy loam is in capability subclass VIIe, dryland; capability unit VIe–14, irrigated; Shallow Sandy range site. Rock land is in capability subclass VIIIs, dryland; range site not assigned.

Ethete Series

The Ethete series consists of well-drained soils underlain by stratified sand and gravel at a depth of 20 to 40 inches. These soils are on terraces along the Big Wind River. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 50° F., and the frost-free period is 110 to 140 days. The dominant vegetation is big sagebrush, western wheatgrass, Indian ricegrass, and Sandberg bluegrass.

In a representative profile the surface layer is light brownish-gray loam about 4 inches thick. The subsoil is brown to pale-brown clay loam about 17 inches thick. The upper part of the substratum is white gravelly clay loam about 13 inches thick, and the lower part of the substratum is light brownish-gray very gravelly sand to a depth of 60 inches or more. The soil is mildly to strongly alkaline. It is calcareous throughout.

Figure 11.—Profile of Enos sandy loam. The depth to sandstone is 34 inches.

Ethete loam, 0 to 3 percent slopes (EtA).—This nearly level soil is on terraces. The surface is generally smooth.

Representative profile in native pasture, SW¼SW¼ of sec. 29, T. 3 N., R. 1 E., (fig. 12):

A1—0 to 4 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; mildly alkaline (pH 7.5); gradual, smooth boundary.

B2t—4 to 14 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; moderate numbers of thin patchy clay films on all ped surfaces; 10 percent gravel; calcareous; moderately alkaline (pH 8.2); clear, wavy boundary.

B3ca—14 to 21 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, subangular blocky structure; hard, very friable;

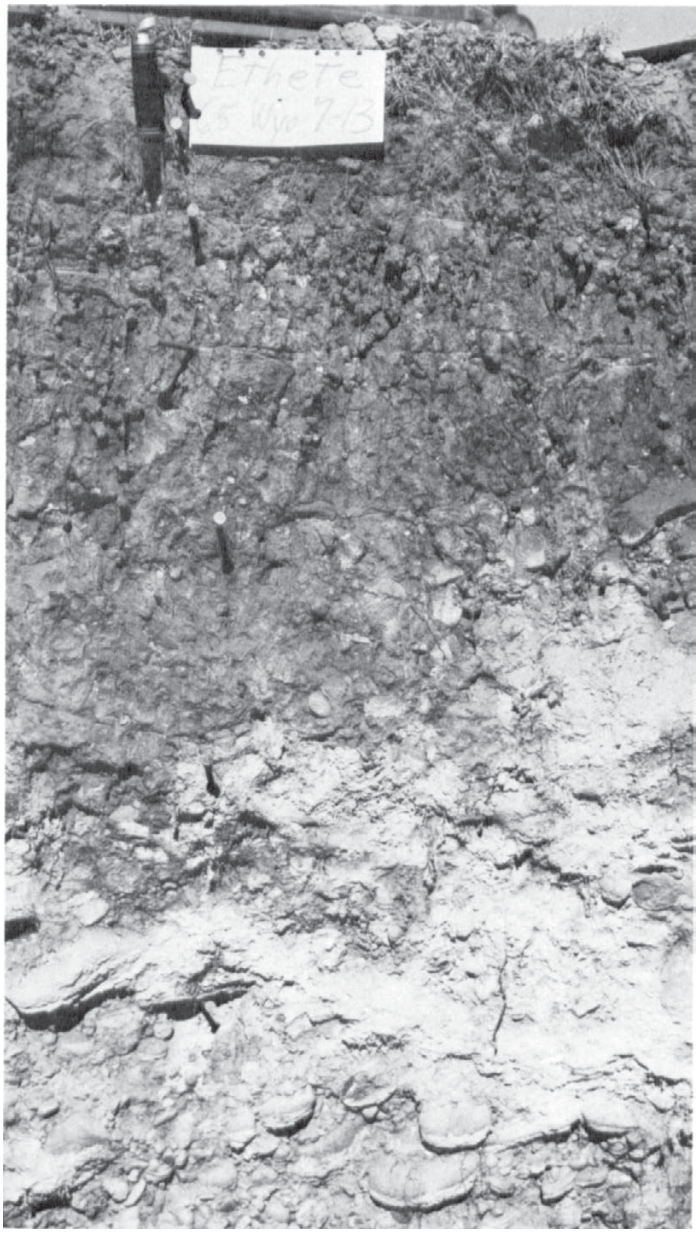

Figure 12.—Profile of Ethete loam. The depth to gravel is 34 inches.

few, thin, patchy clay films, principally on the vertical surfaces of the peds; 10 percent gravel; secondary calcium carbonate occurs as concretions and in thin seams and streaks; calcareous; strongly alkaline (pH 8.7); abrupt, wavy boundary.

C1ca—21 to 34 inches, white (10YR 8/2) gravelly clay loam, light gray (10YR 7/2) moist; massive; hard, very friable; 20 percent gravel; secondary calcium carbonate occurs in finely divided marl-like form; calcareous; strongly alkaline (pH 9.0); clear, wavy boundary.

IIC2ca—34 to 60 inches, light brownish-gray (10YR 6/2) very gravelly sand; dark grayish brown (10YR 4/2) moist; single grained; loose; 60 percent gravel and cobblestones; secondary calcium carbonate present mostly as coatings on pebbles; calcareous; strongly alkaline (pH 9.0).

This soil may be calcareous to the surface. Color of the A and B horizons ranges in hue from 2.5Y to 7.5YR. Depth to very gravelly sand is 20 to 40 inches.

Included with this soil in mapping are small areas of Griffy loam, Apron sandy loam, and Clifterson gravelly loam.

Permeability is moderate in this Ethete soil, and runoff is slow. Available water capacity is 5 to 7 inches. Roots can penetrate to a depth of 60 inches or more. The hazards of wind and water erosion are slight.

Ethete soils are used for irrigated crops and pasture, range, community and recreational purposes, windbreaks, and as wildlife habitat. Sugar beets, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. The city of Riverton is located mainly on this soil. Windbreaks are planted around farmsteads. Some recreational developments are on this soil. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIs, dryland; capability unit IIs–2, irrigated; Loamy range site.

Ethete loam, 3 to 6 percent slopes (EtB).—This gently sloping soil is on terraces. Depth to very gravelly sand is 20 to 30 inches. Included in mapping are about 40 acres of Ethete loam that has 6 to 10 percent slopes. Runoff is medium, and the hazard of water erosion is moderate.

This soil is used similarly to Ethete loam, 0 to 3 percent slopes. Capability subclass VIe, dryland; capability unit IIIe–2, irrigated; Loamy range site.

Ethete loam, saline, 0 to 6 percent slopes (EuB).—This nearly level to gently sloping soil is slightly saline and somewhat poorly drained. It has a water table at a depth of 3 to 5 feet during much of the growing season. The salinity and wetness are the result of excess irrigation.

Included with this soil in mapping are small areas of Saline wet land, Wet alluvial land, and Ethete loam.

The hazard of water erosion is slight to moderate, and runoff is slight to medium.

This soil is used for irrigated crops and pasture, range, and as wildlife habitat. Sugar beets, small grains, and pasture plants are grown in irrigated areas. Pheasants and cottontail rabbits are the principal wildlife. Special onsite investigation is necessary to determine if these soils can be reclaimed. Until reclamation can be accomplished, only plants of moderate salt tolerance, such as inland saltgrass and alkali sacaton, will thrive. Capability subclass VIws, dryland; capability unit IIIws–11, irrigated; Saline Subirrigated range site.

Fivemile Series

The Fivemile series consists of well-drained sandy clay loams or silty clay loams. They formed in stratified, mixed alluvium on low terraces and high bottom lands. These soils are along Fivemile and Muddy Creeks and at Pilot Butte Oil Field. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is Gardner saltbush, western wheatgrass, Indian ricegrass, and bottlebrush squirreltail on the silty clay loam soils and big sagebrush, western wheatgrass, and grama on the sandy clay loam soils.

In a representative profile the surface layer is light brownish-gray silty clay loam about 5 inches thick. The underlying material is grayish-brown silty clay loam stratified with lenses of silt loam, loam, clay loam, and very fine sandy loam to a depth of 60 inches or more. The soil is moderately alklaine and calcareous throughout.

Fivemile soils are associated with Binton soils.

Fivemile silty clay loam, 0 to 3 percent slopes (FnA).—This nearly level soil is on low terraces and high bottom lands.

Representative profile in a cultivated field, about 160 feet west and 70 feet north of the east quarter corner of sec. 4, T. 3 N., R. 2 E.:

Ap—0 to 5 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; moderate, fine, granular structure; soft, friable, plastic; calcareous; moderately alkaline (pH 8.4); gradual, wavy boundary.

C—5 to 60 inches, grayish-brown (10YR 5/2) silty clay loam stratified with lenses of silt loam, loam, clay loam, and very fine sandy loam; dark grayish brown (10YR 4/2) moist; massive; slightly hard, firm, plastic; calcareous; moderately alkaline (pH 8.4).

Color of the soil ranges in hue from 10YR to 7.5YR. Reaction of the C horizon ranges from pH 8.2 to 8.6. In places small amounts of gravel are present in the profile.

Included with this soil in mapping are small areas of Binton silty clay loam.

Permeability is moderately slow in this Fivemile soil, and runoff is slow. Available water capacity is 10 to 12 inches. Roots can penetrate to a depth of 60 inches or more. Hazards of wind and water erosion are slight.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. A large acreage of this soil has been fenced to exclude livestock as an erosion-control measure along Fivemile Creek. Capability subclass VIIc, dryland; capability unit IIc–1, irrigated; Saline Upland range site.

Fivemile silty clay loam, 3 to 6 percent slopes (FnB).—This gently sloping soil occupies stream terraces. Runoff is medium, and the hazard of water erosion is moderate.

This soil is used similarly to Fivemile silty clay loam, 0 to 3 percent slopes. Capability subclass VIIe, dryland; capability unit IIIe–1, irrigated; Saline Upland range site.

Fivemile silty clay loam, saline, 0 to 6 percent slopes (FoB).—This soil is slightly saline, and it is somewhat poorly

drained. The water table is at a depth of 3 to 5 feet during the irrigation season. The salinity and drainage problems are the result of excess irrigation. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Included with this soil in mapping are small areas of Saline wet land and Wet alluvial land.

This soil is used for irrigated crops and pasture, for range, and as wildlife habitat. Sugar beets and small grains are grown in irrigated areas. The soil is used mainly for pasture. Special onsite investigation is necessary to determine if these soils can be reclaimed. Until reclamation is accomplished, only plants of moderate salt tolerance will thrive. The dominant vegetation is alkali sacaton, inland saltgrass, and western wheatgrass. Capability subclass VIws, dryland; capability unit IIIws–10, irrigated; Saline Subirrigated range site.

Fivemile sandy clay loam, 0 to 3 percent slopes (FmA).—This nearly level soil has a sandy clay loam surface layer that is 8 to 18 inches in thickness.

Included with this soil in mapping are small areas of Fivemile silty clay loam, Lostwells sandy clay loam, and Glenton sandy loam.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. The dominant vegetation is big sagebrush, western wheatgrass, and blue grama. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIc, dryland; capability unit IIc–16, irrigated; Loamy range site.

Fruita Series

The Fruita series consists of well-drained clay loams that formed in strongly alkaline material. These soils are mainly in the area between Riverton and Kinnear. They occupy long, nearly level to gently sloping alluvial fans below outcrops of alkaline clay shales. Elevation ranges from 5,000 to 5,500 fet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is birdfoot sagebrush, Gardner saltbush, western wheatgrass, and bottlebrush squirreltail.

In a representative profile the surface layer is light brownish-gray clay loam about 4 inches thick. The subsoil is light brownish-gray clay loam about 16 inches thick. The substratum is light brownish-gray clay loam. It is stratified with lenses of sandy clay loam and sandy loam to a depth of 60 inches or more. The soil is strongly alkaline and calcareous throughout.

Fruita soils are associated with Apron and Griffy soils.

Fruita clay loam, 0 to 3 percent slopes (FrA).—This nearly level soil is on alluvial fans. It has a rilled surface.

Representative profile in native range, SE¼NE¼ of sec. 21, T. 2 N., R. 2 E.:

A1—0 to 4 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, fine, granular structure; soft, friable; 5 percent gravel; calcareous; strongly alkaline (pH 8.6); gradual, smooth boundary.

B2t—4 to 15 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm, sticky and plastic; thin, nearly continuous clay films on all ped surfaces; 5 percent gravel; calcareous; strongly alkaline (pH 8.7); gradual, wavy boundary.

B3ca—15 to 20 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, firm, sticky and plastic; thin, nearly continuous clay films on all ped surfaces; 5 percent gravel; calcareous; strongly alkaline (pH 8.9); gradual, wavy boundary.

Cca—20 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam stratified with lenses of sandy clay loam and sandy loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; 5 percent gravel; secondary calcium carbonate occurring as concretions and in thin seams and streaks; calcareous; strongly alkaline (pH 8.5 to 9.0).

Gravel content is as much as 15 percent. These soils are underlain by clay shale or sandstone at a depth of 40 inches or more in places.

Included with this soil in mapping are small areas of Apron sandy loam, Griffy loam, Lostwells sandy clay loam, Pavillion sandy clay loam, and Effington sandy clay loam.

Permeability is moderately slow in this Fruita soil, and runoff is medium. Available water capacity is 7 to 9 inches. Roots can penetrate to a depth of 40 inches or more. The hazard of wind and water erosion is slight.

This soil is used for range and for such irrigated crops as alfalfa, barley, and oats. It is also used as wildlife habitat. Capability subclass VIs, dryland; capability unit IVs–12, irrigated; Alkali Uplands range site.

Fruita clay loam, 3 to 6 percent slopes (FrB).—This gently sloping soil is on alluvial fans. Runoff is rapid, and the hazard of water erosion is moderate.

This soil is used similarly to Fruita clay loam, 0 to 3 percent slopes. Capability subclass VIe, dryland; capability unit IVs–12, irrigated; Alkali Uplands range site.

Glenton Series

The Glenton series consists of well-drained, stratified sandy loams. They formed in mixed material along Big Wind River and Fivemile Creek. These soils occupy nearly level flood plains. Elevation ranges from 4,500 to 5,000 feet. Annual precipitation is about nine inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is cottonwoods, willows, big sagebrush, and western wheatgrass.

In a representative profile the surface layer is light brownish-gray sandy loam about 8 inches thick. The underlying material is light brownish-gray sandy loam that is stratified with thin lenses of very fine sandy loam, loamy very fine sand, loam, clay loam, and silty clay loam to a depth of 60 inches or more. The soil material is moderately alkaline and strongly calcareous.

Glenton sandy loam (Gn).—This nearly level soil is on flood plains where the stream channel is deeply entrenched.

Representative profile in an alfalfa field, SW¼SE¼ of sec. 7, T. 3 N., R. 3 E.:

Ap—0 to 8 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; soft, very friable; strongly

calcareous; moderately alkaline (pH 8.4); abrupt, smooth boundary.

C—8 to 60 inches, light brownish-gray (10YR 6/2) sandy loam stratified with thin lenses of very fine sandy loam, loamy very fine sand, loam, clay loam, and silty clay loam; dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; strongly calcareous; moderately alkaline (pH 8.4).

Hue ranges from 10YR to 7.5YR. In places the C horizon is silty clay loam below a depth of 30 inches. Gravel content in the profile ranges from 0 to 6 percent.

Included with this soil in mapping are small areas of Fivemile sandy clay loam.

Permeability is moderately rapid in this Glenton soil, and runoff is slow. Available water capacity is 6 to 7.5 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of wind erosion is moderate, and the hazard of water erosion is slight.

This soil is used for irrigated crops and pasture, range, windbreaks, and recreation, and as wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. Much of the developed area of Boysen State Park is on this soil. Pheasants, cottontail rabbits, and deer are the principal wildlife. Capability subclass VIc, dryland; capability unit IIe–5, irrigated; Lowland range site.

Griffy Series

The Griffy series consists of well-drained loams that formed in mixed material. These nearly level to sloping soils are in the southern part of the survey area on terraces and alluvial fans. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, western wheatgrass, Indian ricegrass, and blue grama.

In a representative profile the surface layer is light brownish-gray loam about 4 inches thick. The upper part of the subsoil is brown sandy clay loam about 11 inches thick. The lower part is very pale brown fine sandy loam about 4 inches thick. The substratum is pale-yellow fine sandy loam to a depth of 60 inches or more. The soil is mildly alkaline to strongly alkaline, and it is calcareous in the lower part of the subsoil and in the substratum.

Griffy soils are associated with Ethete and Fruita soils.

Griffy loam, 0 to 3 percent slopes (GrA).—This nearly level soil is on terraces along the Big Wind River. The surface is generally smooth.

Representative profile in native range, NE¼SW¼ of sec. 12, T. 1 N., R. 3 E.:

A1—0 to 4 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure, weakly platy in upper half inch; soft, very friable; mildly alkaline (pH 7.6); gradual, smooth boundary.

B2t—4 to 15 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, coarse, prismatic structure parting to moderate, coarse, subangular blocky; slightly hard, very friable; nearly continuous clay films on all ped surfaces; 5 percent gravel; mildly alkaline (pH 7.8); clear, wavy boundary.

B3ca—15 to 19 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure; slightly hard, friable; few, thin, patchy clay films on some vertical ped surfaces; 5 percent gravel; secondary calcium carbonate present as concretions and in thin seams and streaks; calcareous; moderately alkaline (pH 8.2); gradual, smooth boundary.

Cca—19 to 60 inches, pale-yellow (2.5Y 7/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, friable; secondary calcium carbonate present as concretions, as thin seams and streaks, and as coatings on gravel fragments; 10 percent gravel; calcareous; strongly alkaline (pH 8.8).

Gravel content in the Cca horizon ranges from 5 to 30 percent and generally increases with depth.

Included with this soil in mapping are small areas of Ethete loam, Fruita clay loam, and Apron sandy loam.

Permeability is moderate in this Griffy soil, and runoff is slow. Available water capacity is 8 to 10 inches. Roots can penetrate to a depth of 60 inches or more. The hazards of wind and water erosion are slight.

This soil is used for irrigated crops and pasture, range, windbreaks, community and recreational developments, and wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIc, dryland; capability unit IIc–16, irrigated; Loamy range site.

Griffy loam, 3 to 6 percent slopes (GrB).—This gently sloping soil is on terraces and alluvial fans. Runoff is medium, and the hazard of water erosion is moderate.

This soil is used similarly to Griffy loam, 0 to 3 percent slopes. Capability subclass VIe, dryland; capability unit IIIe–2, irrigated; Loamy range site.

Griffy loam, 6 to 10 percent slopes (GrC).—This sloping soil is on alluvial fans. Runoff is rapid, and the hazard of water erosion is severe.

This soil is used similarly to Griffy loam, 0 to 3 percent slopes, but no row crops are grown. Capability subclass VIe, dryland; capability unit IVe–2, irrigated; Loamy range site.

Gullied Land

Gullied land (GU) consists of gullies that have cut into friable soils. Individual areas are a large single gully or a network of large and small ones. In places braided gullies leave remnant blocks that appear as small buttes. In most areas this land type is still eroding. Included in mapping are outcrops of sandstone and shale.

This land type generally is associated with Fivemile and Lostwells soils.

It is suited to use as wildlife habitat and recreational areas. Much of it along Fivemile Creek is controlled by the Bureau of Reclamation, and in these places livestock is excluded. In some areas along Fivemile Creek, erosion is retarded by the use of drops and riprap, and by planting willow and Russian-olive. The areas of trees provide good habitat for pheasants and cottontail rabbits. Capability subclass VIIIe, dryland; range site not assigned.

Lostwells Series

The Lostwells series consists of well-drained sandy clay loams. These soils formed in mixed material. Lostwells soils are present throughout the survey area. They

occupy nearly level to sloping alluvial fans. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, western wheatgrass, and blue grama.

In a representative profile the surface layer is light brownish-gray sandy clay loam about 10 inches thick. The underlying material is light brownish-gray sandy clay loam stratified with thin lenses of sandy loam and clay loam to a depth of 60 inches or more. The soil is moderately alkaline and calcareous throughout.

Lostwells soils are associated with Apron and Teapo soils.

Lostwells sandy clay loam, 0 to 3 percent slopes (LoA).—This nearly level soil is on alluvial fans. The surface is generally smooth (fig. 13).

Representative profile in an alfalfa field, about 903 feet west and 327 feet south of the northeast corner of sec. 15, T. 1 N., R. 4 E.:

Ap—0 to 10 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; calcareous; moderately alkaline (pH 8.4); clear, smooth boundary.

C—10 to 60 inches, light brownish-gray (10YR 6/2) sandy clay loam stratified with thin lenses of sandy loam and clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable; weak and inconsistent accumulation of secondary calcium carbonate, principally as soft masses and thin seams and streaks; calcareous; moderately alkaline (pH 8.4).

Color of the soil ranges in hue from 10YR to 2.5Y. The C horizon ranges in clay content from 20 to 35 percent. The soil generally contains a few pebbles throughout.

Included with this soil in mapping are small areas of Apron sandy loam, Teapo sandy clay loam, and Youngston silty clay loam.

Permeability is moderately slow in this Lostwells soil, and runoff is slow. Available water capacity is 8 to 10 inches. Roots can penetrate to a depth of 60 inches or more. The hazards of wind and water erosion are slight.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIc, dryland; capability unit IIc–16, irrigated; Loamy range site.

Lostwells sandy clay loam, 3 to 6 percent slopes (LoB).—This gently sloping soil is on alluvial fans. It is slightly coarser in texture than Lostwells sandy clay loam, 0 to 3 percent slopes. Runoff is medium, and the hazard of water erosion is moderate.

This soil is used similarly to Lostwells sandy clay loam, 0 to 3 percent slopes. Capability subclass VIe, dryland; capability unit IIIe–2, irrigated; Loamy range site.

Lostwells sandy clay loam, 6 to 10 percent slopes (LoC).—This sloping soil is in areas along drainageways that dissect alluvial fans. It contains more coarse material and is less stratified than Lostwells sandy clay loam, 0 to 3 percent slopes. Runoff is rapid, and the hazard of water erosion is severe.

Figure 13.—**Profile of Lostwells sandy clay loam, 0 to 3 percent slopes, the most extensively irrigated soil in the survey area.**

This soil is used similarly to Lostwells sandy clay loam, 0 to 3 percent slopes, but row crops are not grown. Capability subclass VIe, dryland; capability unit IVe–2, irrigated; Loamy range site.

Lostwells sandy clay loam, alkali, 0 to 6 percent slopes (LsB).—This nearly level to gently sloping soil is strongly alkaline and has many slick spots on the surface. Permeability is slow, and runoff is slow to medium. The hazard of water erosion is slight to moderate.

Included with this soil in mapping are small areas of Binton silty clay loams and Boysen sandy clay loam. Birdfoot sagebrush and Indian ricegrass are the dominant vegetation.

This soil is used for irrigated crops and pasture, range, and as wildlife habitat. Sugar beets, small grains, alfalfa, corn for silage, and pasture plants are grown in irrigated areas. Capability subclass VIs, dryland; capability unit IVs–12, irrigated; Saline Upland range site.

Lostwells sandy clay loam, saline, 0 to 6 percent slopes (LtB).—This nearly level to gently sloping soil is slightly saline and somewhat poorly drained. The water table is at a depth of 3 to 5 feet during the irrigation season. The salinity and drainage problems are the result of excess irrigation. Runoff is slow to medium, and the hazard of erosion is moderate.

Included with this soil in mapping are small areas of Saline wet land, Wet alluvial land, and Lostwells sandy clay loam. Inland saltgrass and alkali sacaton are the dominant vegetation.

This soil is used for irrigated crops and pasture, for range, and as wildlife habitat. Sugar beets, small grains, and pasture plants are grown in irrigated areas. Special onsite investigation is necessary to determine if these soils can be reclaimed. Capability subclass VIws, dryland; capability unit IIIws–10, irrigated; Saline Subirrigated range site.

Marsh

Marsh (Ma) consists of very poorly drained soils of various textures. They are in swales and depressions. These areas are covered by water during the entire year. The surface layer is very soft and will not support the weight of livestock or man. Included in mapping are small areas of Wet alluvial land and open water. Cattails are the principal vegetation.

This land type is used as wildlife habitat. Ducks and muskrat are the principal wildlife. Capability subclass VIIIw, dryland; range site not assigned.

Meeteetse Series

The Meeteetse series consists of well-drained soils that have a clay subsoil. They formed in mixed material on alluvial fans and foot slopes. Meeteetse soils are mainly along Eight Mile Road and on Muddy Ridge, but are also present in places throughout the survey area. These soils are nearly level to gently sloping. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is birdfoot sagebrush, alkali dropseed, and blue grama.

In a representative profile the surface layer is pale-brown sandy clay loam about 3 inches thick. The subsoil is light-brown clay about 15 inches thick. The substratum is light reddish-brown clay loam and sandy clay loam to a depth of 60 inches or more. The soil is strongly to very strongly alkaline, and it is calcareous throughout.

Meeteetse soils are associated with Mudray, Birdsley, Boysen, and Tipperary soils.

Meeteetse soils, 0 to 6 percent slopes (MEB).—This nearly level to gently sloping complex occupies alluvial fans and foot slopes. It consists of about 35 percent Meeteetse loamy sand and 25 percent Meeteetse sandy clay loam.

Included with these soils in mapping are Mudray loamy sand that makes up 20 percent of the mapped areas, Birdsley clay loam that makes up 15 percent of the mapped areas, and Boysen sandy clay loam that makes up 5 percent of the mapped areas. Also included in mapping are small areas of Persayo sandy clay loam, Mudray sandy clay loam, and Apron sandy loam.

Representative profile of Meeteetse sandy clay loam in an area of Meeteetse soils, 0 to 6 percent slopes, in native range, NE¼NE¼ of sec. 23, T. 4 N., R. 4 E.:

A2—0 to 3 inches, pale-brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, friable; 5 percent gravel; strongly calcareous; strongly alkaline (pH 8.9); abrupt, irregular boundary.

B2t—3 to 18 inches, light-brown (7.5YR 6/4) clay, brown (7.5YR 5/4) moist; strong, coarse, prismatic structure grading to columnar structure that parts to moderate, coarse and medium, blocky; extremely hard, very sticky and very plastic; tongues of A2 material in this horizon; thick, continuous clay films on all ped surfaces; few pebbles; splotches of carbonates on surface of secondary structure; strongly calcareous; very strongly alkaline (pH 9.6); abrupt, wavy boundary.

C—18 to 60 inches, light reddish-brown (5YR 6/3) clay loam stratified with sandy clay loam, dark reddish gray (5YR 4/2) moist; massive; very hard, sticky and plastic; strongly calcareous; very strongly alkaline (pH 9.4).

Permeability is slow in these Meeteetse soils, and runoff is medium. Available water capacity is 5 to 6 inches. Roots can penetrate to a depth of 40 inches or more. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

The soils of this mapping unit are used for range and as wildlife habitat. Capability subclass VIIs, dryland. Meeteetse loamy sand is in Sandy range site. Meeteetse sandy clay loam is in Alkali Uplands range site.

Meeteetse loamy sand, 0 to 6 percent slopes (MdB).—This soil has a thick, loamy sand mantle that is 20 to 30 inches thick over the very strongly alkaline subsoil. The vegetation is needle-and-thread, Indian ricegrass, and blue grama. Runoff is slow. The hazard of wind erosion is severe, and the hazard of water erosion is slight.

This soil is used for range. Capability subclass VIe, dryland; Sandy range site.

Mudray Series

The Mudray series consists of well-drained sandy clay loams that are underlain by clay shale at a depth of 10 to 20 inches. These nearly level to gently sloping soils are on uplands and are mainly on Muddy Ridge. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is birdfoot sagebrush, Gardner saltbush, bottlebrush squirreltail, and blue grama.

In a representative profile the surface layer is light-brown sandy clay loam about 2 inches thick. The subsoil is brown sandy clay loam about 10 inches thick. The substratum is reddish-brown sandy clay loam about 5 inches thick. It is underlain by clay shale. The soil is strongly to very strongly alkaline, and it is calcareous throughout.

Mudray soils are associated with Meeteetse, Boysen, and Birdsley soils.

Mudray-Meeteetse sandy clay loams, 0 to 6 percent slopes (MtB).—In this complex are nearly level to gently sloping soils on uplands and foot slopes. The surface is rilled. This complex consists of about 55 percent Mudray sandy clay loam and 45 percent Meeteetse sandy clay loam. Included in mapping are small areas of Boysen sandy clay loam, Effington sandy clay loam, and Birdsley clay loam.

Representative profile of Mudray sandy clay loam in native range, NE¼NE¼ of sec. 23, T. 4 N., R. 4 E.:

A2—0 to 2 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak, very fine, crumb structure; slightly hard, friable; many pebbles on surface; 10 percent gravel; strongly calcareous; strongly alkaline (pH 8.9); abrupt, irregular boundary.

B2t—2 to 12 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; strong, coarse, columnar structure; extremely hard, very firm; sticky and plastic; continuous clay films with frosting of sand grains on all ped surfaces; strongly calcareous; very strongly alkaline (pH 9.2); diffuse, irregular boundary.

C1ca—12 to 17 inches, reddish-brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; massive; extremely hard, very firm, sticky and plastic; segregation of carbonate as large, soft masses; strongly calcareous; very strongly alkaline (pH 9.4); diffuse, wavy boundary.

IIC2—17 inches, pinkish gray, platy, calcareous, very strongly alkaline clay shale.

Depth to clay shale or sandstone is 10 to 20 inches.

Permeability is slow in this Mudray soil, and runoff is moderate to rapid. Available water capacity is 1 to 3 inches. Roots can penetrate to a depth of 10 to 20 inches. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

This complex is used for range and as wildlife habitat. Capability subclass VIIs, dryland; Alkali Uplands range site.

Mudray-Meeteetse loamy sands, 0 to 6 percent slopes (MmB).—This nearly level to gently sloping complex is on uplands and foot slopes. The surface is undulating to hummocky with many coppice mounds. Vegetation is needle-and-thread, Indian ricegrass, and blue grama. Runoff is slow. The hazard of wind erosion is severe, and the hazard of water erosion is slight.

This complex consists of about 55 percent Mudray loamy sand and 45 percent Meeteetse loamy sand. The Meeteetse loamy sand has a surface layer 4 to 12 inches thick, and the Mudray loamy sand has a surface layer 4 to 6 inches thick. Included in mapping are small areas of Mudray sandy clay loam, Meeteetse sandy clay loam, and Effington sandy clay loam.

This complex is used for range and as wildlife habitat. Capability subclass VIIs, dryland. Meeteetse loamy sand is in Sandy range site. Mudray loamy sand is in Shallow Sandy range site.

Oceanet Series

The Oceanet series consists of well-drained sandy loams that are underlain by sandstone at a depth of 0 to 20 inches. These nearly level to steep soils are on uplands throughout the area. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, Indian ricegrass, and blue grama.

In a representative profile light yellowish-brown sandy loam about 14 inches thick is underlain by sandstone. The soil is moderately alkaline and calcareous throughout.

Oceanet soils are associated with Worland, Apron, and Persayo soils.

Oceanet sandy loam, 0 to 10 percent slopes (OcC).—This soil occupies nearly level to sloping uplands. The surface is slightly hummocky and has many coppice mounds.

Representative profile in native range, about 550 feet north and 200 feet east of the west quarter corner of sec. 34, T. 3 N., R. 3 E.:

A1—0 to 5 inches, light yellowish-brown (2.5Y 6/3) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, fine, crumb structure; soft, very friable; calcareous; moderately alkaline (pH 8.2); gradual, smooth boundary.

C1—5 to 14 inches, light yellowish-brown (2.5Y 6/3) sandy loam, light olive brown (2.5Y 5/3) moist; single grained; slightly hard, very friable; many partly weathered sandstone fragments soft enough to be crushed in the hand; calcareous; moderately alkaline (pH 8.4); gradual, wavy boundary.

IIC2—14 inches, yellowish-brown, soft, calcareous sandstone.

Depth to sandstone ranges from 10 to 20 inches. The gravel content ranges from 0 to 6 percent.

Included with this soil in mapping are small areas of Worland sandy loam, Persayo sandy clay loam, and Rock land. Also included are 94 acres of Oceanet sandy loam, 10 to 30 percent slopes.

Permeability is moderately rapid in this Oceanet soil, and runoff is slow to medium. Available water capacity is 1 to 2 inches. Roots can penetrate to a depth of 10 to 20 inches. The hazards of wind and water erosion are moderate.

This soil is used for range and as wildlife habitat. Chukars are the principal wildlife. Capability subclass VIIe, dryland; Shallow Sandy range site.

Oceanet-Rock land association, hilly (ORE).—This hilly association is on uplands. Areas consist of about 65 percent Oceanet sandy loam and about 35 percent Rock land. The rock in the land type Rock land is sandstone. Small areas of Persayo sandy clay loam, Worland sandy loam, and Apron sandy loam are included in mapping. Runoff is rapid, and the hazard of water erosion is severe. Slope ranges from 0 to 30 percent.

This association is used for range and as wildlife habitat. Chukars are the principal wildlife. Oceanet sandy loam is in capability subclass VIIe, dryland; Shallow Sandy range site. Rock land is in capability subclass VIIIs, dryland; range site not assigned.

Pavillion Series

The Pavillion series consists of well-drained sandy clay loams that are underlain by clay shale or sandstone at a depth of 20 to 40 inches. They formed in mixed material. These soils are throughout the area. They occupy nearly level to sloping uplands and foot slopes. Elevation ranges from 4,800 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is

about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, Indian ricegrass, needle-and-thread, and blue grama.

In a representative profile the surface layer is light brownish-gray sandy clay loam about 3 inches thick. The subsoil is brown sandy clay loam about 15 inches thick. The substratum is light brownish-gray sandy clay loam about 14 inches thick. It is underlain by clay shale. The soil material is moderately to strongly alkaline, and it is calcareous throughout.

Pavillion soils are associated with Apron and Birdsley soils.

Pavillion sandy clay loam, 3 to 10 percent slopes (PaC).—This gently sloping to sloping soil is on uplands and foot slopes. The surface generally has coppice mounds.

Representative profile in native range, NE¼SE¼ of sec. 34, T. 3 N., R. 1 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; contains a few pebbles; noncalcareous; moderately alkaline (pH 8.0); clear, smooth boundary.

B2—3 to 18 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; few, thin, patchy clay films on the vertical surfaces of some peds; few pebbles; calcareous; moderately alkaline (pH 8.3); gradual, wavy boundary.

C1ca—18 to 32 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; secondary calcium carbonate occurring as concretions and in thin seams and streaks; a few scattered pebbles; strongly calcareous; strongly alkaline (pH 8.5); abrupt, wavy boundary.

IIC2—32 inches, gray, platy, soft, calcareous clay shale.

The texture of the A horizon ranges from sandy loam to sandy clay loam. The soil may be calcareous to the surface. This soil is underlain by clay shale or sandstone at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Worland sandy loam, Teapo sandy clay loam, Saddle sandy clay loam, Persayo sandy clay loam, Oceanet sandy loam, and Birdsley clay loam.

Permeability is moderate in this Pavillion soil, and runoff is medium to rapid. Available water capacity is 4 to 6 inches. Roots can penetrate to a depth of 20 to 40 inches. The hazard of wind erosion is moderate, and the hazard of water erosion is moderate to severe.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Alfalfa, small grains, and pasture plants are grown in irrigated areas. Sugar beets, corn for silage, and dry beans are also grown in areas where this soil is gently sloping. Jackrabbits are the principal wildlife. Capability subclass VIe, dryland; capability unit IVe–2, irrigated; Loamy range site.

Pavillion sandy clay loam, 0 to 3 percent slopes (PaA).—This nearly level soil is on uplands and foot slopes. Runoff is slow, and the hazard of water erosion is slight.

This soil is used similarly to Pavillion sandy clay loam, 3 to 10 percent slopes. Capability subclass VIs, dryland; capability unit IVs–2, irrigated; Loamy range site.

Pavillion sandy clay loam, alkali, 0 to 6 percent slopes (PcB).—This nearly level to gently sloping soil is strongly alkaline. Included in mapping are small areas of Fruita clay loam, Pavillion sandy clay loam, and Apron sandy loam. The dominant vegetation is birdfoot sagebrush, big sagebrush, and Indian ricegrass.

Permeability is moderately slow in this soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for irrigated cropland and pasture, range, and as wildlife habitat. Sugar beets, alfalfa, corn for silage, small grains, and pasture plants are grown in irrigated areas. Capability subclass VIs, dryland; capability unit IVs–12, irrigated; Saline Upland range site.

Persayo Series

The Persayo series consists of well-drained soils that are underlain by clay shale at a depth of 10 to 20 inches. These soils are throughout the area. They occupy nearly level to steep uplands. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, rabbitbrush, Indian ricegrass, and western wheatgrass.

In a representative profile light olive-gray sandy clay loam, about 14 inches thick, is underlain by soft shale. The soil material is moderately alkaline and calcareous throughout.

Persayo soils are associated with Oceanet, Birdsley, Pavillion, Teapo, and Lostwells soils.

Persayo sandy clay loam, 0 to 30 percent slopes (PeE).—This nearly level to moderately steep soil is on uplands. The surface layer is rilled and has many gullies.

Representative profile in native range, about 820 feet south and 200 feet west of the north quarter corner of sec. 15, T. 2 N., R. 2 E.:

A1—0 to 2 inches, light olive-gray (5Y 6/2) sandy clay loam, olive gray (5Y 5/2) moist; strong, very fine, granular structure; thin surface crust; soft, friable; a few pebbles; calcareous; moderately alkaline (pH 8.3); abrupt, smooth boundary.

C1—2 to 14 inches, light olive-gray (5Y 6/2) sandy clay loam, olive gray (5Y 5/2) moist; massive; hard, firm, sticky and plastic; many shale fragments; strongly calcareous; moderately alkaline (pH 8.4); abrupt, wavy boundary.

IIC2—14 inches, gray, platy, soft, calcareous clay shale.

Hue ranges from 2.5Y to 5Y. Texture ranges from sandy clay loam to clay loam. Depth to shale is 10 to 20 inches. In places the bedrock is sandstone. Soil reaction ranges from moderately to strongly alkaline.

Included with this soil in mapping are small areas of Oceanet sandy loam, Teapo sandy clay loam, and Birdsley clay loam.

Permeability is moderately slow in this Persayo soil and runoff is medium to rapid. Available water capacity is 1 to 3 inches. Roots can penetrate to a depth of 10 to 20 inches. The hazard of water erosion is moderate to severe, and the hazard of wind erosion is slight.

This soil is used for irrigated pasture, for range, and as wildlife habitat. Chukars are the principal wildlife. Capability subclass VIIe, dryland; capability unit VIe–14, irrigated where slopes are 0 to 15 percent; Shallow Clayey range site.

Persayo-Oceanet association, steep (POD).—This steep association occupies uplands. Slopes are 0 to 30 percent.

Runoff is rapid, and the hazard of water erosion is severe. This mapping unit consists of about 55 percent Persayo sandy clay loam, 30 percent Oceanet sandy loam, and 15 percent Rock land. Included in mapping are small areas of Worland sandy loam, Teapo sandy clay loam, and Apron sandy loam.

This association is used for range and as wildlife habitat. Chukars are the principal wildlife. Persayo sandy clay loam is in capability subclass VIIe, dryland; Shallow Clayey range site. Oceanet sandy loam is in capability subclass VIIe, dryland; Shallow Sandy range site. Rock land is in capability subclass VIIIs, dryland; range site not assigned.

Persayo-Worland association, hilly (PRE).—This sloping to steep association is on uplands. Slopes are 8 to 20 percent. Runoff is rapid, and the hazard of water erosion is severe. This mapping unit consists of about 40 percent Persayo sandy clay loam, 35 percent Worland sandy loam, and 10 percent Rock land. Included in mapping are small areas of Teapo sandy clay loam, Apron sandy loam, and Lostwells sandy clay loam.

This association is used for range and as wildlife habitat. Chukars are the principal wildlife. Persayo sandy clay loam is in capability subclass VIIe, dryland; Shallow Clayey range site. Worland sandy loam is in capability subclass VIe, dryland; Sandy range site. Oceanet sandy loam is in capability subclass VIIe, dryland; Shallow Sandy range site. Rock land is in capability subclass VIIIs, dryland; range site not assigned.

Rock Land

Rock land (RS) consists of areas of exposed rock. It is principally sandstone and clay shale but includes granite, siltstone, and limestone. This land type is in rough, broken and mountainous areas. Included in mapping are small areas of Persayo, Oceanet, and Clifterson soils.

This land type is suitable for use as wildlife habitat. Chukars and deer are the principal types of wildlife. Capability subclass VIIIs, dryland; range site not assigned.

Saddle Series

The Saddle series consists of well-drained sandy clay loams that are underlain by clay shale and sandstone at a depth of 20 to 40 inches. These nearly level to sloping soils are mainly in the area between Pilot Butte and Riverton. They are on uplands. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, needle-and-thread, western wheatgrass, and blue grama.

In a representative profile the surface layer is light brownish-gray sandy loam about 3 inches thick. The subsoil is brown to pale-brown sandy clay loam about 18 inches thick. The substratum is very pale brown sandy clay loam about 9 inches thick. It is underlain by clay shale at a depth of about 30 inches. The soil is neutral to strongly alkaline, and it is calcareous in the lower part of the subsoil and in the substratum.

Saddle soils are associated with Griffy, Apron, Lostwells, and Pavillion soils.

Saddle sandy clay loam, 3 to 10 percent slopes (SaC).—This gently sloping to sloping soil is on uplands. The surface has many coppice mounds.

Representative profile in native pasture, about 900 feet west and 100 feet north of the southeast corner of sec. 27, T. 3 N., R. 1 E. (fig. 14):

A1—0 to 3 inches, light brownish-gray (10YR 6/2) sandy loam, dark brown (10YR 4/3) moist; weak, fine, crumb structure; soft, very friable; contains a few pebbles; neutral (pH 7.0); abrupt, smooth boundary.

B2t—3 to 12 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; strong, medium, prismatic structure parting to strong, medium, blocky; hard, firm, sticky and plastic; continuous clay films on vertical surfaces of peds and patchy clay films on horizontal surfaces; contains a few pebbles, moderately alkaline (pH 8.2); abrupt wavy boundary.

B3ca—12 to 21 inches, pale-brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure; slightly hard, friable,

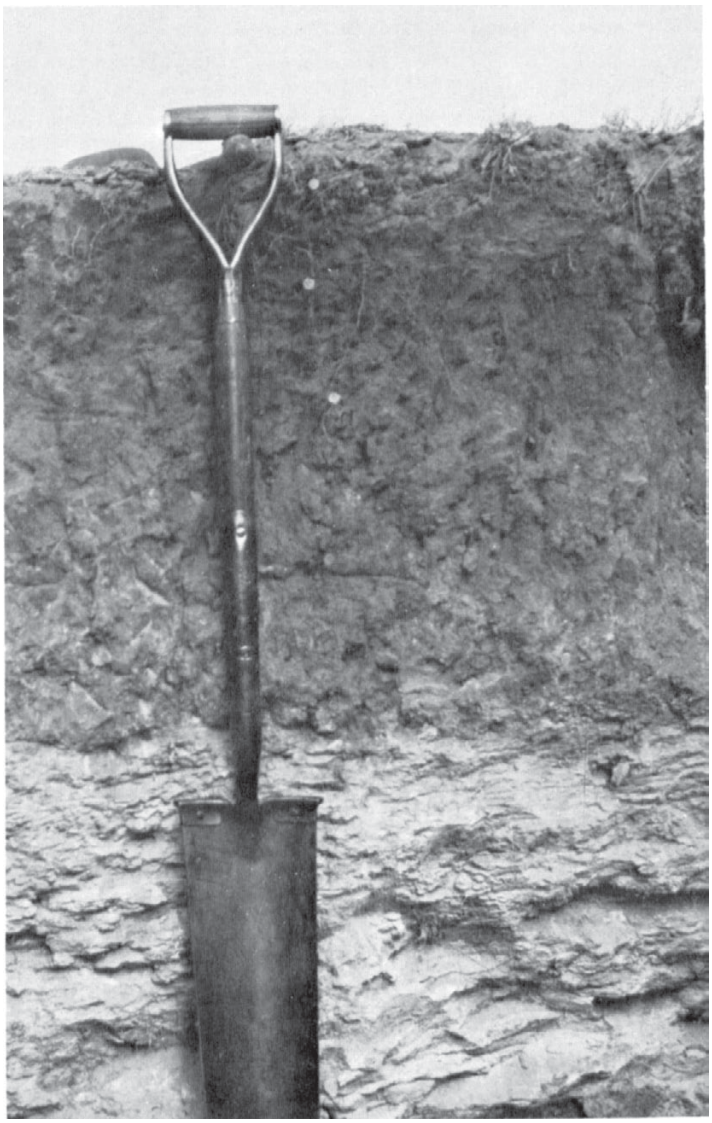

Figure 14.—**Profile of Saddle sandy clay loam. The depth to clay shale is 30 inches.**

few, thin, patchy clay films on all ped surfaces; contains a few pebbles; secondary calcium carbonate present as concretions and streaks; strongly calcareous; strongly alkaline (pH 8.6); clear, wavy boundary.

C1ca—21 to 30 inches, very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable; secondary calcium carbonate present as concretions and thin seams and streaks; strongly calcareous; strongly alkaline (pH 8.8); abrupt, wavy boundary.

IIC2—30 inches, greenish-gray, platy, soft, calcareous clay shale.

Hue ranges from 10YR to 7.5YR. Depth to clay shale or sandstone is 20 to 40 inches.

Included with this soil in mapping are small areas of Apron sandy loam, Pavillion sandy clay loam, Fruita clay loam, and Griffy loam. Also included are 94 acres of a shallow Saddle variant.

Permeability is moderate in this Saddle soil, and runoff is medium to rapid. Available water capacity is 4 to 6 inches. Roots can penetrate to a depth of 20 to 40 inches. The hazard of water erosion is moderate to severe, and the hazard of wind erosion is moderate.

This soil is used for irrigated crops and pasture, range, and as wildlife habitat. Alfalfa, small grains, and pasture plants are grown in irrigated areas. Jackrabbits are the principal wildlife. Capability subclass VIe, dryland; capability unit IVe–2, irrigated; Loamy range site.

Saddle sandy clay loam, 0 to 3 percent slopes (SaA).—This nearly level soil is on uplands. Runoff is slow, and the hazard of water erosion is slight.

Included with this soil in mapping are 49 acres of a shallow Saddle variant.

This soil is used for irrigated crops and pasture, for range, and as wildlife habitat. Sugar beets, small grains, alfalfa, and pasture plants are grown in irrigated areas. Capability subclass VIs, dryland; capability unit IVs–2, irrigated; Loamy range site.

Saline Wet Land

Saline wet land (Sw) consists of nearly level to gently sloping soils with such a high accumulation of soluble salts that it becomes the predominant feature. These soils are somewhat poorly drained to poorly drained. Patches of thick salt crust commonly are on the surface.

Available water capacity ranges from 4 to 11 inches.

Saline wet land is used for irrigated pasture and range. Capability subclass VIws, dryland; capability unit VIs–71, irrigated; Saline Subirrigated range site.

Teapo Series

The Teapo series consists of well-drained sandy clay loams that are underlain by shale or sandstone at a depth of 20 to 40 inches. They formed in mixed material. These nearly level to gently sloping soils are throughout the area. They occupy foot slopes. Elevation ranges from 4,500 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, Indian ricegrass, western wheatgrass, and blue grama.

In a representative profile the soil is pale-brown sandy clay loam to a depth of about 30 inches. This material is underlain by soft clay shale. The soil is moderately alkaline and calcareous throughout.

Teapo soils are associated with Lostwells soils.

Teapo sandy clay loam, 3 to 6 percent slopes (TcB).—This gently sloping soil is on foot slopes. The surface is generally smooth.

Representative profile in an alfalfa field, about 1,600 feet north and 450 feet east of the southwest corner of sec. 20, T. 3 N., R. 6 E.:

Ap—0 to 9 inches, pale-brown (10YR 6/3) sandy clay loam; dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, friable; contains a few pebbles; calcareous; moderately alkaline (pH 8.2); abrupt, smooth boundary.

C1—9 to 30 inches, pale-brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; hard, friable; a few pebbles and sandstone fragments; calcareous; moderately alkaline (pH 8.4); abrupt, wavy boundary.

IIC2—30 inches, gray, platy, soft, calcareous clay shale.

Depth to clay shale or sandstone ranges from 20 to 40 inches.

Included with this soil in mapping are small areas of Lostwells sandy clay loam, Persayo sandy clay loam, and Pavillion sandy clay loam. Also included are 55 acres of Teapo sandy clay loam, 10 to 15 percent slopes.

Permeability is moderate in this and the other Teapo soils, and runoff is medium. Available water capacity is 4 to 6 inches. Roots can penetrate to a depth of 20 to 40 inches. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Sugar beets, dry beans, small grains, alfalfa, corn for silage, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIe, dryland; capability unit IVe–2, irrigated; Loamy range site.

Teapo sandy clay loam, 0 to 3 percent slopes (TcA).—This nearly level soil is on foot slopes. Runoff is slow, and the hazard of water erosion is slight.

This soil is used similarly to Teapo sandy clay loam, 3 to 6 percent slopes. Capability subclass VIs, dryland; capability unit IVs–2, irrigated; Loamy range site.

Teapo sandy clay loam, saline, 0 to 6 percent slopes (TeB).—This nearly level to gently sloping soil is slightly saline and somewhat poorly drained. The water table is at a depth of 2 to 4 feet. The salinity and drainage problems are the result of excess irrigation. Alkali sacaton and inland saltgrass are the dominant vegetation. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included with this soil in mapping are small areas of Saline wet land.

This soil is used for irrigated crops and pasture, for range, and as wildlife habitat. Sugar beets, small grains, and pasture plants are grown in irrigated areas. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIws, dryland; capability unit IVws–10, irrigated; Saline Subirrigated range site.

Tipper Series

The Tipper series consists of somewhat excessively drained loamy sands that are underlain by sandstone at a depth of 20 to 40 inches. These soils are mainly along the west side of Boysen Reservoir. They occupy hilly uplands. Elevation ranges from 4,800 to 5,200 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, needle-and-thread, and blue grama.

In a representative profile the soil is light yellowish-brown loamy sand about 26 inches thick. It is underlain by soft sandstone. The soil is moderately to strongly alkaline and calcareous throughout.

Tipper soils are associated with Tipperary and Oceanet soils.

Representative profile in native range, SE¼SE¼ of sec. 12, T. 3 N., R. 5 E.:

A1—0 to 6 inches, light yellowish-brown (2.5Y 6/4) loamy sand, light olive brown (2.5Y 5/4) moist; single grained; loose; few pebbles on surface and throughout; calcareous; moderately alkaline (pH 8.3); gradual, wavy boundary.

C1—6 to 26 inches, light yellowish-brown (2.5Y 6/4) loamy sand, light olive brown (2.5Y 5/4) moist; single grained; loose; few pebbles throughout; calcareous; strongly alkaline (pH 8.6); clear, wavy boundary.

IIC2—26 inches, gray, slightly calcareous sandstone.

These soils are generally calcareous throughout but in places are noncalcareous in the upper few inches. The depth to sandstone ranges from 20 to 40 inches.

Permeability is rapid in this Tipper soil, and runoff is slow. Available water capacity is 1 to 3 inches. Roots can penetrate to a depth of 20 to 40 inches. The hazard of water erosion is slight, and the hazard of wind erosion is severe.

The Tipper series is only mapped as a component of the Tipperary-Tipper association.

Tipperary Series

The Tipperary series consists of somewhat excessively drained sands. They formed in loose sand. These nearly level to moderately steep soils are mainly on Cottonwood Bench. They occupy terraces, alluvial fans, and uplands. Elevation ranges from 4,800 to 5,300 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is prairie sandreed, needle-and-thread, and Indian ricegrass.

In a representative profile the surface layer is light brownish-gray loamy sand about 5 inches thick. The underlying material is light brownish-gray sand to a depth of 60 inches or more. The soil is moderately alkaline and calcareous throughout.

Tipperary soils are associated with Trook soils.

Tipperary loamy sand, 0 to 6 percent slopes (TmB).—This nearly level to gently sloping soil is on terraces and alluvial fans. The surface is slightly hummocky because of wind activity.

Representative profile in native pasture, about one-quarter mile west of the southeast corner of sec. 23, T. 4 N., R. 4 E.:

A1—0 to 5 inches, light brownish-gray (10YR 6/2) loamy sand, grayish brown (10YR 5/2) moist; single grained; loose; 5 percent gravel; calcareous; moderately alkaline (pH 8.2); gradual, wavy boundary.

C—5 to 60 inches, light brownish-gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grained; loose; 5 percent gravel; calcareous; moderately alkaline (pH 8.4).

These soils are generally calcareous throughout but in places are noncalcareous in the upper few inches. The texture of the C horizon is generally sand but in places is loamy sand.

Included with this soil in mapping are small areas of Trook sandy loam, Apron sandy loam, and Meeteetse loamy sand.

Permeability is rapid in this and the other Tipperary soils, and runoff is slow. The available water capacity is 4 to 5 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of wind erosion is severe, and the hazard of water erosion is slight.

This soil is used for irrigated crops and pasture, for range, and as wildlife habitat. Alfalfa and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads and along some fields. Pheasants, cottontail rabbits, and sage chickens are the principal wildlife. Capability subclass VIe, dryland; capability unit IVe–15, irrigated; Sands range site.

Tipperary loamy sand, 6 to 10 percent slopes (TmC).—This sloping soil is on alluvial fans below steep upland breaks. Included in mapping are small areas of Trook sandy loam, Apron sandy loam, Worland sandy loam, Tipper loamy sand, and Oceanet sandy loam. Also included are 100 acres of Tipperary loamy sand, 10 to 15 percent slopes.

This soil is used for range and as wildlife habitat. Sage chickens are the principal wildlife. Capability subclass VIe, dryland; Sands range site.

Tipperary loamy sand, alkali, hummocky (TnD).—These very strongly alkaline soils occupy hummocky terraces. Slopes are 6 to 15 percent. Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is severe. The vegetation is predominantly greasewood.

This soil is used for range and as wildlife habitat. Jackrabbits are the principal wildlife. Capability subclass VIIs, dryland; Saline Lowland range site.

Tipperary-Tipper association, hilly (TOE).—This association is in areas where windblown sand is mantling sandstone on hilly uplands. Slopes are 6 to 15 percent. The surface is hummocky. This mapping unit consists of about 40 percent Tipperary loamy sand, 35 percent Tipper loamy sand, and 25 percent Oceanet sandy loam. Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is severe.

Included with these soils in mapping are small areas of Rock land, Worland sandy loam, Apron sandy loam, and Meeteetse loamy sand.

This association is used for range and as wildlife habitat. Jackrabbits and antelope are the principal wildlife. Tipperary loamy sand and Tipper loamy sand are in capability subclass VIe, dryland; Sands range site. Oceanet sandy loam is in capability subclass VIIe, dryland; Shallow Sandy range site.

Tipperary-Trook association, hilly (TRE).—This association is on terrace breaks. Slopes are 6 to 20 percent. This mapping unit consists of about 50 percent Tipperary loamy sand and 40 percent Trook sandy loam. Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

Included with these soils in mapping are 5 percent Oceanet sandy loam and about 5 percent Persayo sandy clay loam. Small areas of Worland sandy loam, Rock land, Clifterson gravelly loam, and Apron sandy loam are also included.

This association is used for range and as wildlife habitat. Sage chickens are the principal wildlife. Tipperary loamy sand is in capability subclass VIe, dryland; Sands range site. Trook sandy loam is in capability subclass VIe, dryland; Sandy range site.

Trook Series

The Trook series consists of well-drained sandy loams that formed in mixed material. These soils are mainly in the northern part of the survey area. They occupy outwash terraces and alluvial fans. Elevation ranges from 4,800 to 5,300 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, threadleaf sedge, and blue grama.

In a representative profile the surface layer is pale-brown sandy loam about 7 inches thick. It is underlain by pale brown and very pale brown sandy loam about 20 inches thick. The substratum is white and pale-brown gravelly sandy loam to a depth of 60 inches or more. The soil is moderately to strongly alkaline and calcareous throughout.

Trook soils are associated with Tipperary and Apron soils.

Trook sandy loam, 0 to 3 percent slopes (TsA).—This nearly level soil is on outwash terraces. The surface is generally smooth.

Representative profile in native range, NE¼SE¼ of sec. 9, T. 4 N., R. 3 E.:

A1—0 to 7 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; moderate, fine, granular structure; soft, very friable; a few pebbles; calcareous; moderately alkaline (pH 8.2); clear, wavy boundary.

C1ca—7 to 12 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; a few pebbles; secondary calcium carbonate occurring as concretions and in thin seams and streaks; strongly calcareous; moderately alkaline (pH 8.4); diffuse, wavy boundary.

C2ca—12 to 27 inches, very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; a few pebbles; secondary calcium carbonate occurring as concretions, in seams and streaks, as coatings on pebbles, and as finely divided marl; calcium carbonate equivalent exceeds 15 percent; strongly calcareous; strongly alkaline (pH 8.7); diffuse, irregular boundary.

IIC3ca—27 to 42 inches, white (10YR 8/2) gravelly sandy loam, light gray (10YR 7/2) moist; massive; slightly hard, very friable; 20 percent gravel; calcium carbonate occurring as marl and as coatings on pebbles; calcium carbonate equivalent exceeds 15 percent; strongly calcareous; strongly alkaline (pH 9.0); diffuse, irregular boundary.

IIC4—42 to 60 inches, pale-brown (10YR 6/3) gravelly sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; 20 percent gravel; calcareous; strongly alkaline (pH 8.6).

Content of coarse material ranges from 5 to 35 percent in the C horizon. Very gravelly layers are below a depth of 40 inches in places. The gravel is subrounded and relates to rocks found in the Owl Creek Mountains to the north.

Included with this soil in mapping are small areas of Clifterson gravelly loam, Apron sandy loam, and Ethete loam.

Permeability is moderately rapid in this Trook soil, and runoff is slow. Available water capacity is 5 to 7 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of wind erosion is moderate, and the hazard of water erosion is slight.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIe, dryland; capability unit IIe–5, irrigated; Sandy range site.

Trook sandy loam, 3 to 6 percent slopes (TsB).—This gently sloping soil occupies outwash fans. Runoff is medium. The hazard of water erosion is moderate.

This soil is used similarly to Trook sandy loam, 0 to 3 percent slopes. Capability subclass VIe, dryland; capability unit IIIe–5, irrigated; Sandy range site.

Trook sandy loam, 6 to 10 percent slopes (TsC).—This soil is on breaks between nearly level outwash terraces, along drainageways crossing outwash terraces, and in alluvial fans from terrace breaks. The hazard of water erosion is moderate. Runoff is medium.

This soil is used principally for range, but small areas are used for irrigated crops, pasture, and as wildlife habitat. Alfalfa, small grains, and pasture plants are grown in irrigated areas. Capability subclass VIe, dryland; capability unit IVe–5, irrigated; Sandy range site.

Trook sandy loam, saline, 0 to 6 percent slopes (TtB).—This nearly level to gently sloping soil is slightly saline and somewhat poorly drained. The water table is at a depth of 3 to 5 feet. The salinity and drainage problems are the results of excess irrigation. Alkali sacaton and inland saltgrass are the dominant vegetation. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Included with this soil in mapping are small areas of Saline wet land and Trook sandy loam.

This soil is used for small grains, irrigated pasture, range, and as wildlife habitat. Capability subclass VIws, dryland; capability unit IIIws–11, irrigated; Saline Subirrigated range site.

Trook-Apron association, gently sloping (TUB).—This association is on outwash terraces and on alluvial fans below outwash terraces. The surface is crossed by many drainageways. Slopes are 0 to 6 percent. This mapping unit consists of about 70 percent Apron sandy loam and 30 percent Trook sandy loam. Runoff is medium, and the hazard of water erosion is moderate.

Included with this association in mapping are small areas of Worland sandy loam, Oceanet sandy loam, Lostwells sandy clay loam, Persayo sandy clay loam, Fruita clay loam, and Fivemile silty clay loam.

This association is used for range and as wildlife habitat. Sage chickens and jackrabbits are the principal wildlife. Capability subclass VIe, dryland; Sandy range site.

Trook-Clifterson association, moderately steep (TVD).—This association is on the breaks of outwash terraces and in areas of dissected alluvial fans below these breaks. Slopes are 3 to 15 percent. Numerous drainageways cut the areas. This mapping unit consists of about

35 percent Trook sandy loam, 30 percent Clifterson gravelly loam, 20 percent Apron sandy loam, and 15 percent Persayo sandy clay loam. Runoff is rapid, and the hazard of water erosion is severe.

Included with this soil in mapping are small areas of Griffy loam, Ethete loam, Worland sandy loam, Oceanet sandy loam, Pavillion sandy clay loam, and Tipperary loamy sand.

This association is used for range and as wildlife habitat. Trook sandy loam and Apron sandy loam are in capability subclass VIe, dryland; Sandy range site. Clifterson gravelly loam is in capability subclass VIe, dryland; Gravelly range site. Persayo sandy clay loam is in capability subclass VIIe, dryland; Shallow Clayey range site.

Wall Series

The Wall series consists of well-drained sandy loams that formed in loose sands on uplands. These gently sloping to hummocky soils are in the central part of the survey area between Pilot Butte Reservoir and an area northeast of Riverton. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, Indian ricegrass, and blue grama.

In a representative profile the surface layer is light brownish-gray loamy sand about 4 inches thick. The subsoil is light brownish-gray and grayish-brown sandy loam about 21 inches thick. The substratum is light brownish-gray loamy sand to a depth of 60 inches or more. The soil is moderately alkaline and calcareous in the lower part of the profile.

Wall soils are associated with Enos and Oceanet soils.

Representative profile in native range, about 280 feet north and 80 feet east of center of sec. 20, T. 3 N., R. 1 E.:

A1—0 to 4 inches, light brownish-gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grained; loose, noncalcareous; mildly alkaline (pH 7.7); abrupt, smooth boundary.

B1—4 to 9 inches, light brownish-gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; soft, very friable; thin, patchy clay films on vertical surfaces of peds, clay bridges between sand grains; noncalcareous; moderately alkaline (pH 7.9); clear, smooth boundary.

B2—9 to 14 inches, grayish-brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure; slightly hard, very friable, slightly sticky; thin, patchy clay films on all ped surfaces, clay bridges between some sand grains; noncalcareous; moderately alkaline (pH 7.9); clear, wavy boundary.

B3—14 to 25 inches, light brownish-gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grained; loose; noncalcareous; moderately alkaline (pH 8.0); diffuse, wavy boundary.

C—25 to 60 inches, light brownish-gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grained; loose; slightly calcareous; moderately alkaline (pH 8.2).

The B horizon ranges in clay content from 12 to 18 percent. Carbonates have been leached to a depth of 16 to 30 inches. Small amounts of gravel are present in some profiles.

Permeability is moderately rapid in this Wall soil, and runoff is slow. Available water capacity is 4 to 5 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of water erosion is slight, and the hazard of wind erosion is severe.

The Wall series is mapped only as a component of the Enos-Wall association.

Wet Alluvial Land

Wet alluvial land (Wa) consists of poorly drained soils in swales and on flood plains. These soils have a saline water table at or near the surface during most of the growing season. The soils are mottled and have gleyed horizons. The dominant vegetation is cattails, sedges, and rushes. Small areas of Marsh are included in mapping.

Most areas of this land type are used as wildlife habitat. Some areas are used for range, but in places the soft soil material is a hazard to livestock. Ducks and muskrats are the principal wildlife. Capability subclass VIw, dryland; Wetland range site.

Winkleman Series

The Winkleman series consists of well-drained silty clays that formed in clayey material. These soils are mainly west of Ocean Lake. They occupy nearly level valley fills. Elevation ranges from 5,000 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is Gardner saltbush, bottlebrush squirreltail, western wheatgrass, and Indian ricegrass.

In a representative profile the surface layer is light brownish-gray silty clay about 7 inches thick. The underlying material is light brownish-gray silty clay that has thin strata of silty clay loam to a depth of 60 inches or more. The soil is moderately alkaline and calcareous throughout.

Winkleman soils are in association with Lostwells, Teapo, Worland, and Apron soils.

Winkleman silty clay (Wc).—This nearly level soil is on valley fills. The surface is generally smooth.

Representative profile in an alfalfa field, about 210 feet north and 60 feet east of the southwest corner of sec. 33, T. 3 N., R. 2 E.:

Ap—0 to 7 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, fine, subangular blocky structure; very hard, firm, sticky and plastic; strongly calcareous; moderately alkaline (pH 8.3); clear, wavy boundary.

C—7 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay with thin strata of silty clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; strongly calcareous; moderately alkaline (pH 8.4).

Gravel content ranges from 0 to 10 percent. In the C horizon, strata having texture nearly comparable to that of the surrounding soil, but varying in color or organic content, are common. The hue of the C horizon ranges from 10YR to 5Y.

Included with this soil in mapping are small areas of Lostwells sandy clay loam and Winkleman silty clay, saline. Also included are 40 acres of Winkleman silty clay, 3 to 6 percent slopes.

Permeability is slow in this Winkleman soil, and runoff is slow. Available water capacity is 8 to 10 inches. Roots can penetrate to a depth of 60 inches or more. The hazards of wind and water erosion are slight.

All the acreage of this soil is used for irrigated crops and pasture or as wildlife habitat. Small grains, alfalfa, and pasture plants are grown in irrigated areas. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIs, dryland; capability unit IIIs–1, irrigated; range site not assigned.

Winkleman silty clay, saline (We).—This nearly level soil is slightly saline and somewhat poorly drained. The water table is at a depth of 3 to 5 feet during the irrigation season. The salinity and drainage problems are the result of excess irrigation. Inland saltgrass and alkali sacaton are the dominant vegetation. Runoff is very slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of Saline wet land, Winkleman silty clay, and Winkleman silty clay, wet.

This soil is used for irrigated pasture. Capability subclass VIws, dryland; capability unit VIws–10, irrigated; range site not assigned.

Winkleman silty clay, wet (Wk).—This nearly level soil is poorly drained. There is a saline water table at a depth of 0 to 1 foot during most of the growing season. During seasons when the water table drops, there may be patches of salt crust on the surface. Runoff is very slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of Winkleman silty clay, saline. Sedges and rushes are the dominant vegetation.

This soil is used for pasture. Capability subclass VIw, dryland; range site not assigned.

Worland Series

The Worland series consists of well-drained sandy loams that are underlain. at a depth of 20 to 40 inches, by sandstone. These nearly level to sloping soils are present throughout the survey area. They occupy uplands and foot slopes. Elevation ranges from 4,500 to 5,500 feet. Annual precipitation is about 9 inches, average annual soil temperature is 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, blue grama, and needle-and-thread.

In a representative profile the soil is grayish-brown to light brownish-gray sandy loam about 30 inches thick. It is underlain by sandstone. The soil is moderately alkaline and calcareous throughout.

Worland soils are associated with Apron and Oceanet soils.

Worland sandy loam, 3 to 6 percent slopes (WoB).—This soil occupies uplands and foot slopes. The surface is generally smooth.

Representative profile in native range, about 1,450 feet west and 660 feet south of the northeast corner of sec. 6, T. 3 N., R. 2 E.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; soft, very friable; a few pebbles; calcareous; moderately alkaline (pH 8.2); gradual, wavy boundary.

C1—4 to 30 inches, light brownish-gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; calcareous; moderately alkaline (pH 8.4); abrupt, wavy boundary.

IIC2—30 inches, yellowish-brown, calcareous sandstone.

In places small amounts of gravel are in the profile. Depth to sandstone ranges from 20 to 40 inches.

Included with this soil in mapping are small areas of Apron sandy loam, Enos sandy loam, and Oceanet sandy loam.

Permeability is moderately rapid in this Worland soil, and runoff is medium. Available water capacity is 3½ to 5 inches. Roots can penetrate to a depth of 20 to 40 inches. The hazards of wind and water erosion are moderate.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn for silage, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIe, dryland; capability unit IVe–5, irrigated; Sandy range site.

Worland sandy loam, 0 to 3 percent slopes (WoA).—This nearly level soil occupies foot slopes. The surface is generally smooth. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

This soil is used similarly to Worland sandy loam, 3 to 6 percent slopes. Capability subclass VIe, dryland; capability unit IVe–5, irrigated; Sandy range site.

Worland sandy loam, 6 to 10 percent slopes (WoC).—This sloping soil occupies uplands. Many coppice mounds are on the surface. Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Alfalfa, small grains, and pasture plants are grown in irrigated areas. Capability subclass VIe, dryland; capability unit IVe–5, irrigated; Sandy range site.

Worland sandy loam, saline, 0 to 6 percent slopes (WrB).—This nearly level to gently sloping soil is slightly saline and somewhat poorly drained. The water table is at a depth of 2 to 4 feet. The salinity and drainage problems are the result of excess irrigation.

Included with this soil in mapping are small areas of Saline wet land; Apron sandy loam, saline; and Worland sandy loam. The dominant vegetation is alkali sacaton, inland saltgrass, and western wheatgrass.

This soil is used for irrigated crops and pasture, range, and as wildlife habitat. Sugar beets, small grains, and pasture plants are grown in irrigated areas. Capability subclass VIws, dryland; capability unit IVws–10, irrigated; Saline Subirrigated range site.

Worland-Oceanet complex, 0 to 10 percent slopes (WSC).—This complex is on uplands. The surface is slightly hummocky. This complex is about 50 percent Worland sandy loam and 40 percent Oceanet sandy loam.

About 10 percent Rock land is included with these soils in mapping, along with small areas of Apron sandy loam, Enos sandy loam, Wall loamy sand, Saddle sandy clay loam, and Persayo sandy clay loam.

This complex is used for range and as wildlife habitat. Chukars are the principal wildlife. Capability subclass VIIe, dryland. Worland sandy loam is in Sandy range

site. Oceanet sandy loam is in Shallow Sandy range site. Rock land is not assigned a range site.

Youngston Series

The Youngston series consists of well-drained clay loams that formed in mixed material. These soils are mainly in Missouri and Paradise Valleys on alluvial fans. Elevation ranges from 4,800 to 5,400 feet. Annual precipitation is about 9 inches, average annual soil temperature is about 51° F., and the frost-free period is 120 to 140 days. The dominant vegetation is big sagebrush, Indian ricegrass, western wheatgrass, and blue grama.

In a representative profile the surface layer is light brownish-gray clay loam about 8 inches thick. The underlying material is light brownish-gray clay loam stratified with thin lenses of sandy clay loam, silty clay loam, and sandy loam to a depth of 60 inches or more. The soil is moderately alkaline and calcareous throughout.

Youngston soils are associated with Lostwells and Fivemile soils.

Youngston clay loam (Yo).—This nearly level soil is on alluvial fans. The surface is generally smooth.

Representative profile in an alfalfa field, about 300 feet south and 50 feet west of the north quarter corner of sec. 26, T. 3 N., R. 3 E.:

Ap—0 to 8 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, very coarse, subangular blocky structure; slightly hard, friable; calcareous; moderately alkaline (pH 8.2); gradual, smooth boundary.

C—8 to 60 inches, light brownish-gray (10YR 6/2) clay loam stratified with thin lenses of sandy clay loam, silty clay loam, and sandy loam; grayish brown (10YR 5/2) moist; massive; hard, firm; strongly calcareous; moderately alkaline (pH 8.4).

In places the soil contains a few pebbles throughout the profile.

Included with this soil in mapping are small areas of Lostwells sandy clay loam and Fivemile silty clay loam. Also included are 124 acres of Youngston clay loam, 3 to 6 percent slopes.

Permeability is moderately slow in this Youngston soil, and runoff is slow. Available water capacity is 10 to 12 inches. Roots can penetrate to a depth of 60 inches or more. The hazard of erosion is slight.

This soil is used for irrigated crops and pasture, range, windbreaks, and as wildlife habitat. Sugar beets, dry beans, alfalfa, small grains, corn, and pasture plants are grown in irrigated areas. Windbreaks are planted around farmsteads. Pheasants and cottontail rabbits are the principal wildlife. Capability subclass VIc, dryland; capability unit IIc–1, irrigated; Clayey range site.

Use and Management of the Soils

This section discusses the use and management of the soils of the survey area for crops and pasture, range, windbreaks, wildlife habitat, engineering, and urban and recreational uses.

Management of the Soils for Crops and Pasture [3]

This section gives principles of soil management for irrigated crops, pasture, and hay. Precipitation in the survey area is inadequate for nonirrigated crops. First the management of irrigated soils in the survey area is discussed in general terms, and then soil capability grouping and management of irrigated and dryland capability groups are explained. Estimated yields of irrigated crops under a high level of management are given in table 2.

Management of irrigated soils

In spring natural moisture is generally adequate for germinating crops. Water supplies also are adequate, and irrigation usually starts near the middle of April. The main crops are sugar beets, dry beans, alfalfa, barley, and corn. Much of the irrigated land is used for pasture.

The major consideration in irrigated soil management is the maintenance of soil structure and fertility, but erosion control is also important. Maintaining soil structure is necessary for good soil tilth, desirable water intake, and adequate soil aeration. The soils should not be tilled when the moisture content is high. Organic matter promotes good soil structure. Legumes, grass, and legume-grass mixture or barnyard manure plowed under help maintain a desirable organic-matter content. The burning of crop residues destroys organic matter and encourages loss of fertility, poor soil tilth, and erosion.

If soil is managed well, fertility is maintained at a high level. Nitrogen is needed for crops or grass. In most places beets and alfalfa need phosphorus. The supplies of potassium and minor elements in the soil are adequate. Soil testing and fertilizer recommendations are available at the Riverton Soils laboratory of the Wyoming Agricultural Experiment Station.

Soils left bare are susceptible to wind erosion. Rough tillage and shelter belts can be helpful in controlling this. Careful use of irrigation water helps to control erosion caused by applied water. If soils are irrigated downslope in areas where slopes are more than 3 percent, erosion is a hazard, and irrigation should be across the slope.

A favorable soil for irrigated crops has a sandy loam to clay loam texture, good structure, and adequate depth. It also has a moderate to high available water capacity and a moderate water intake rate. It is free of excessive salts and alkali and has a water table that is not too high.

The limitations of some of the soils in the survey area are discussed in the following paragraphs.

Excessive alkalinity.—This condition results from an excessive amount of exchangeable sodium in the soil. It causes deterioration of the structure and accompanying low water intake rate, poor tilth, and poor aeration.

Where the substratum allows adequate drainage, gypsum can be applied and the soil reclaimed by leaching. Where drainage through the substratum is restricted, it is best to grow alkali-tolerant crops.

Salinity.—Salinity is caused by an excessive amount of soluble salts, and normally occurs where the water table is high. The salts interfere with plant growth (fig. 15) by making it more difficult for the plants to absorb

[3] ROBERT L. TRESLER, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

Figure 15.—Corn on Lostwells sandy clay loam, saline, 0 to 6 percent slopes. Capability unit IIIws–10, irrigated.

water. Saline soils can be reclaimed by draining and leaching if the substratum permits adequate drainage. If drainage is not feasible, salt-tolerant crops should be grown.

A high water table in the survey area is usually associated with varying degrees of salinity and is generally detrimental to crops. This condition is caused by excess irrigation and by water seeping from ditches and from higher lying soils. If the soil cannot be reclaimed by drainage, salt- and water-tolerant crops should be grown.

Soil depth.—More than 40 inches of soil is desirable for irrigated crops. Soils less than 40 inches deep require more frequent irrigation, have less room for root development, and are less productive.

Slope.—The preferred slope for irrigation is nearly level. Slopes of more than 3 percent are restricted to close-growing crops, because furrows create a hazard of erosion on such slopes. Grass-legume mixtures on slopes of more than 3 percent should include a sod-forming grass. If the slope is more than 10 percent, the vegetation should be at least half sod-forming grass. Slopes of more than 15 percent are unsuitable for surface irrigation.

Sandy soils.—The hazard of wind erosion is severe on sandy soils. A conservation system is needed to provide protection. Sandy soils have rapid water-intake rates and low available water capacity. They require frequent water application to maintain moisture for normal plant growth. Also required is careful application of water to prevent losing it beyond the root zone.

Clayey soils.—These soils require special treatment because of their poor tilth and very slow water-intake rate. They must be tilled when the moisture content is neither too low nor too high. The incorporation of organic matter into the soil is important for good tilth and structure.

USE OF IRRIGATED WATER

Successful irrigated farming depends on the correct use of water. The object of irrigation is to keep soil moisture adequate for normal plant growth. The soil is a resorvoir that can hold a certain amount of water. Plants remove some of this stored water, and then the reservoir needs refilling. This reservoir extends to the depth to which the roots of the plant use water. Water that penetrates beyond this depth is lost to the crop, and it also leaches out soluble plant nutrients.

Guides that are helpful in planning irrigation systems have been prepared by the Soil Conservation Service and cooperating agencies. This information is available at the Soil Conservation Service field office in Riverton.

Capability Grouping

Capability group 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 so used, and the way they respond to treatment. The group does not take into account major and generally expensive landforming that would change slope, depth, or other

characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, 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, the kinds of soil are grouped at three levels; the capability class, subclass, and unit. These are discussed 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. (None in the survey area.)

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in the survey area.)

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.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, saline or alkali, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, 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, IIe–2 or IIIe–5. 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.

Capability units in classes I to VI, irrigated, are generally identified by numbers assigned as part of a statewide system. Because the soils in the survey area are not representative of all the units in the system used in Wyoming, the capability units in this survey are not numbered consecutively. In classes VI to VIII, dryland, the soils are placed in capability subclasses only.

Irrigated soils

Capability groups described in the following paragraphs apply to irrigated soils in the survey area.

CAPABILITY UNIT IIe–5, IRRIGATED

This capability unit consists of nearly level, well-drained, deep sandy loams that are slightly susceptible to water erosion. The hazard of wind erosion is moderate.

These soils are easily cultivated. They have an available water capacity of 6 to 7.5 inches and moderately rapid permeability. The frost-free period is 120 to 140 days.

Dry beans (fig. 16), alfalfa, small grains, sugar beets, and corn are the main crops grown on these soils. Irrigated pasture also is a major use.

These soils are irrigated by furrow or controlled flooding. Some leveling generally is necessary. Irrigation water needs to be applied carefully to control leaching and erosion. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIs–2, IRRIGATED

Ethete loam, 0 to 3 percent slopes, is the only soil in this capability unit. It is a nearly level, well-drained loam over very gravelly sand. This soil is slightly susceptible to wind and water erosion.

These soils are easily cultivated. They have an available water capacity of 5 to 7 inches. Permeability is moderate above the layer of very gravelly sand and rapid in that layer. The frost-free period is 110 to 140 days.

Sugar beets, alfalfa, small grains, and corn for silage are the main crops grown on these soils. Irrigated pasture also is a major use.

This soil is irrigated by furrow, corrugation, or controlled flooding. Some leveling is generally necessary. In leveling, care must be taken to avoid exposing the underlying sand and gravel. Irrigation water needs to be applied carefully to control leaching and erosion.

Figure 16.—Dry beans on Apron sandy loam, 0 to 3 percent slopes. Capability unit IIe–5, irrigated.

Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIc–1, IRRIGATED

This capability unit consists of nearly level, well-drained, deep clay loams and silty clay loams that are slightly susceptible to erosion.

Ideal cultivation conditions exist in only a narrow range of moisture content. Available water capacity is 8 to 12 inches, and permeability is moderately slow. The frost-free period is 120 to 140 days.

Sugar beets, dry beans, alfalfa, small grains, and corn for silage are the main crops on these soils. Irrigated pasture also is a major use.

These soils are irrigated by furrow, corrugation, or controlled flooding. Some leveling is generally necessary. Irrigation water needs to be carefully applied to control leaching and erosion. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIc–16, IRRIGATED

This capability unit consists of nearly level, well-drained, deep sandy clay loams and loams that are slightly susceptible to erosion.

These soils are easily cultivated. Available water capacity is 8 to 12 inches. Permeability is moderate to moderately slow. The frost-free period is 120 to 140 days.

Sugar beets (fig. 17), dry beans, alfalfa, small grains, and corn for silage are the main crops grown on these soils. The soils are also used extensively for irrigated pasture.

These soils are irrigated by furrow, corrugation, or controlled flooding. Some leveling is generally necessary. Irrigation water needs to be carefully applied to

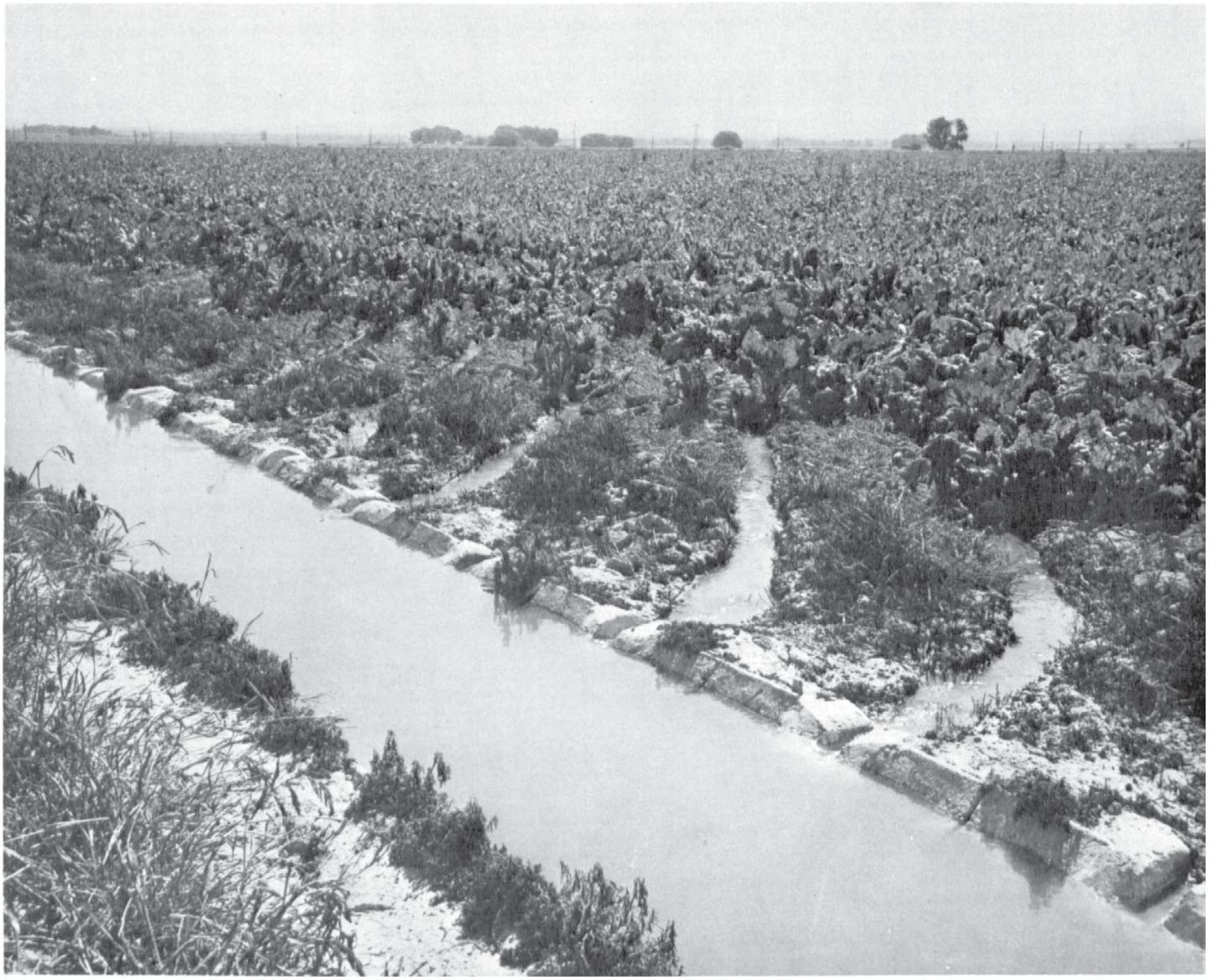

Figure 17.—**Sugar beets on Lostwells sandy clay loam, 0 to 3 percent slopes. Capability unit IIc–16, irrigated.**

control erosion and leaching. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIIe–1, IRRIGATED

Fivemile silty clay loam, 3 to 6 percent slopes, is the only soil in this capability unit. It is a gently sloping, well-drained, deep silty clay loam that is moderately susceptible to water erosion. The hazard of wind erosion is slight.

Ideal cultivation conditions exist only in a narrow range of moisture content. Available water capacity is 8 to 11 inches. Permeability is moderately slow. The frost-free period is 120 to 140 days.

Alfalfa, small grains, sugar beets, dry beans, and corn for silage are the main crops grown on this soil. Irrigated pasture also is a major use.

These soils are irrigated by contour furrow, sprinklers, or controlled flooding from contour ditches. Some leveling is generally necessary. Irrigation water needs to be applied carefully to control erosion and leaching. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIIe–2, IRRIGATED

This capability unit consists of gently sloping, well-drained, deep loams and sandy clay loams that are moderately susceptible to water erosion. Some are underlain by very gravelly sand. The hazard of wind erosion is slight.

These soils are easily cultivated. Available water capacity is 6 to 9 inches. Permeability is moderate to moderately slow. The frost-free period is 110 to 140 days.

Sugar beets, alfalfa, small grains, and corn for silage are the main crops on these soils. Irrigated pasture also

is a major use. Dry beans are a major crop on the Lostwells and Griffy soils.

These soils are irrigated by contour furrow, sprinklers, or controlled flooding from contour ditches. Some leveling is generally necessary. Irrigation water needs to be carefully applied to control leaching and erosion. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIIe–5 IRRIGATED

This capability unit consists of gently sloping, well-drained, deep sandy loams that are moderately susceptible to wind and water erosion.

These soils are easily cultivated. Available water capacity is 6 to 7.5 inches. Permeability is moderately rapid. The frost-free period is 120 to 140 days.

Dry beans, alfalfa (fig. 18), small grains, sugar beets, and corn for silage are the main crops on these soils. Irrigated pasture also is a major use.

These soils are irrigated by contour furrow, sprinklers, or controlled flooding from contour ditches. Some leveling is generally necessary. Irrigation water needs to be applied carefully to control leaching and erosion. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIIs–1, IRRIGATED

Winkleman silty clay is the only soil in this capability unit. It is a nearly level, well-drained, deep silty clay that has a low intake rate. It is subject to slight erosion.

This soil is difficult to cultivate. Available water capacity is 7 to 9 inches. Permeability is slow. The frost-free period is 120 to 140 days.

Alfalfa and small grains are the main crops on this soil. Irrigated pasture is the major use.

These soils are irrigated by furrow, corrugation, and flooding. Some leveling is generally necessary. Irrigation water needs to be carefully applied to control erosion. These soils should not be pastured during or immediately after irrigation, because the trampling by livestock will reduce the already low infiltration rate. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IIIw–63, IRRIGATED

Bigwin sandy loam is the only soil in this capability unit. It is a nearly level, somewhat poorly drained sandy loam that is underlain by stratified sand and gravel. This soil is susceptible to slight water erosion and moderate wind erosion. The water table is nonsaline.

This Bigwin soil is easily cultivated. In places it contains moisture in excess of plant needs. Permeability

Figure 18.—**Baled alfalfa hay on Apron sandy loam, 3 to 6 percent slopes. Capability unit IIIe–5, irrigated.**

is moderately rapid above the water table. The frost-free period is 110 to 140 days.

This soil is used mainly for irrigated pasture. It is also suited to alfalfa and small grains.

This soil is irrigated by flooding. Extreme caution must be exercised to avoid raising the water table when irrigation water is applied. Drainage is generally not feasible, because areas are only slightly higher than the normal level of the adjacent river.

CAPABILITY UNIT IIIws–10, IRRIGATED

This capability unit consists of nearly level to gently sloping, deep soils that have a fluctuating saline water table in the root zone during the growing season. Soluble salts accumulate in the surface layer of these soils. Some areas have patches of salt crust on the surface.

Because of the excess moisture in these soils, they are difficult to cultivate. These soils sometimes contain moisture in excess of plant needs. Permeability is moderately rapid or moderately slow above the water table. The frost-free period is 120 to 140 days.

Sugar beets and small grains are the main crops on these soils. Soils of this capability unit are used mainly for irrigated pasture.

These soils are irrigated by furrow or flooding. When these soils are irrigated, extreme care must be exercised to avoid raising the already high water table. In places artificial drainage is practical on some of these soils.

CAPABILITY UNIT IIIws–11, IRRIGATED

This capability unit consists of nearly level to gently sloping, deep soils that have a gravelly or very gravelly substratum. A fluctuating, saline water table is in the root zone during the growing season. Soluble salts accumulate in the surface layers of these soils. In some areas patches of salt crust are on the surface.

Because of the excess moisture in these soils, they are difficult to cultivate. These soils sometimes contain water in excess of plant needs. Permeability is moderate to moderately rapid above the water table. The frost-free period is 110 to 140 days.

Sugar beets and small grains are the main crops on these soils, but the soils are used mainly for irrigated pasture.

These soils are irrigated by furrow or flooding. Extreme caution must be exercised to avoid raising the already high water table when irrigating these soils. In places artificial drainage is practical on some of these soils.

CAPABILITY UNIT IVe–2, IRRIGATED

This capability unit consists of gently sloping to sloping, well-drained, deep and moderately deep loams and sandy clay loams that are moderately to severely susceptible to erosion. Moderately deep soils are underlain by clay shale and sandstone.

The soils in this unit are easily cultivated. Available water capacity is 3 to 9 inches. Permeability is moderate to moderately slow. The frost-free period is 120 to 140 days.

Alfalfa and small grains are the main crops, but sugar beets and corn for silage are grown in areas of gently sloping soils. Soils in this unit are used mainly for irrigated pasture.

These soils are irrigated by controlled flooding from contour ditches or by sprinkling. On the soils underlain by bedrock, care must be taken to avoid establishing a water table or causing seepage of lower lying areas. Irrigation water needs to be applied carefully to control erosion and leaching. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IVe–4, IRRIGATED

Wall loamy sand is the only soil in this capability unit. It is a nearly level to gently sloping, well-drained, deep soil that is subject to severe wind erosion and slight water erosion.

Care must be taken in cultivating this soil to control wind erosion. Available water capacity is 4 to 5 inches. Permeability is moderately rapid. The frost-free period is 120 to 140 days.

Alfalfa is the main crop grown on this soil. The soil is used mainly for irrigated pasture.

Irrigation is by controlled flooding from contour ditches or by sprinkling. Irrigation water must be applied carefully to control leaching. Field ditches should be lined.

CAPABILITY UNIT IVe–5, IRRIGATED

This capability unit consists of nearly level to sloping, well-drained, deep and moderately deep sandy loams that are moderately to severely susceptible to erosion. The moderately deep soils are underlain by sandstone.

These soils are easily cultivated. Available water capacity is 2 to 7.5 inches. Permeability is moderately rapid. The frost-free period is 120 to 140 days.

Alfalfa and small grains are the main crops on this soil, but sugar beets, dry beans, and corn for silage also are grown in some of the areas of gently sloping soils. The soils are used mainly for irrigated pasture.

These soils are irrigated by controlled flooding from contour ditches or by sprinkling. Leveling is generally not feasible on these soils, but some planning may be necessary. Irrigation water must be carefully applied to control erosion, leaching, and seepage of lower lying areas. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IVe–15, IRRIGATED

Tipperary loamy sand, 0 to 6 percent slopes, is the only soil in this capability unit. It is a nearly level to gently sloping, somewhat excessively drained to excessively drained, deep loamy sand that is subject to severe wind erosion and slight water erosion.

This soil is easily cultivated. Available water capacity is 4 to 5 inches. Permeability is rapid. The frost-free period is 120 to 140 days.

Alfalfa is the main crop in this soil. Irrigated pasture is an important use. In reestablishing alfalfa or pasture, the soil must be protected from the hazard of wind erosion.

This soil is irrigated by controlled flooding or by sprinklers. Irrigation water needs to be applied carefully to help control leaching. Field ditches should be lined.

CAPABILITY UNIT IVs–2, IRRIGATED

This capability unit consists of nearly level, well-drained, moderately deep sandy clay loams that are

underlain by clay shale or sandstone. The hazards of water and wind erosion are slight.

These soils are easily cultivated. Available water capacity is 4 to 6 inches. Permeability is moderate. The frost-free period is 120 to 140 days.

Sugar beets, alfalfa, and small grains are the main crops grown on these soils, but dry beans and corn for silage also are grown. Irrigated pasture is a major use.

These soils are irrigated by furrow, corrugation, or controlled flooding. Some leveling is generally necessary. Care must be taken to avoid exposing the bedrock during leveling operations. Irrigation water needs to be applied carefully to control leaching, erosion, creation of a water table, and seepage to lower lying soils. Unless they have a nonerodible grade, field ditches should be lined.

CAPABILITY UNIT IVs–12, IRRIGATED

This capability unit consists of nearly level to gently sloping, well-drained, deep and moderately deep, strongly alkaline soils. Moderately deep soils are underlain by clay shale or sandstone. The hazard of wind erosion is slight, and the hazard of water erosion is slight to moderate.

These soils are difficult to cultivate because of their poor physical condition, which is caused by alkali. They take in and release water slowly. Permeability is moderately slow to slow. Available water capacity is 4 to 9 inches. The frost-free period is 120 to 140 days.

Very little of the acreage of this capability unit is cultivated. Areas that are cultivated are used for small grains or sugar beets, and some alfalfa and corn for silage are grown. Irrigated pasture is an important use.

Some areas of these soils can be reclaimed by the addition of gypsum, sulphur, or sulphuric acid and leaching. Reclamation should be accomplished before or during irrigation development. After reclamation, these soils should be managed for irrigation as the same soil without the alkali condition would be managed.

CAPABILITY UNIT IVws–10, IRRIGATED

This capability unit consists of nearly level to gently sloping, moderately deep soils that have a saline water table in the root zone during the growing season. They are underlain by clay shale or sandstone. Soluble salts accumulate in the surface horizons of these soils, and in places patches of salt crust are on the surface.

Because of the excess moisture in these soils, they are difficult to cultivate. These soils sometimes contain moisture in excess of plant needs. Permeability is moderate to moderately rapid above the water table. The frost-free period is 120 to 140 days.

Sugar beets and small grains are the main crops, but the principal use of the soils is for irrigated pasture.

These soils are irrigated by furrow or flooding. When these soils are irrigated, extreme care must be exercised to avoid raising the already high water table. Drainage is generally not feasible on these soils because of the underlying shale and sandstone.

CAPABILITY UNIT VIe–14, IRRIGATED

This capability unit consists of nearly level to moderately steep, well-drained, shallow soils that are underlain by clay shale or sandstone. The hazard of water erosion is moderate to severe, and the hazard of wind erosion is slight to moderate. Only the 0 to 15 percent part of Persayo sandy clay loam, 0 to 30 percent slopes, is included in this capability unit.

Available water capacity is 1 to 3 inches. Permeability is moderately rapid to moderately slow. The frost-free period is 120 to 140 days.

These soils are not suitable for cropping. Irrigated pasture is the only irrigated use of these soils.

These soils are irrigated by flooding. Because of shallow depth, leveling is not feasible. Raising the water table of the surrounding soils is the greatest hazard when irrigating these soils.

CAPABILITY UNIT VIs–71, IRRIGATED

This capability unit consists of nearly level to gently sloping, somewhat poorly drained to poorly drained, strongly saline soils (fig. 19).

It is difficult to cultivate most of these soils. Available water capacity is 4 to 11 inches. The frost-free period is 120 to 140 days.

These soils are not suitable for cropping. They are used mainly for irrigated pasture.

These soils are irrigated by flooding. Some of these soils can be reclaimed by drainage and leaching.

CAPABILITY UNIT VIws–10, IRRIGATED

Winkleman silty clay, saline, is the only soil in this capability unit. It is a nearly level, deep silty clay that has a saline water table in the root zone. Soluble salts accumulate in the surface layer of this soil, and some areas have patches of salt crust on the surface.

Because of the excess moisture and the fine texture, this soil is difficult to cultivate. It sometimes contains moisture in excess of plant needs. Permeability is slow. The frost-free period is 120 to 140 days.

This soil is not suitable for cropping. It is used mainly for irrigated pasture.

This soil is irrigated by flooding. Care must be taken to avoid raising the already high water table when irrigating this soil.

Dryland soils

As stated in the explanation of capability grouping, soils in classes VI to VIII, dryland, are placed in capability subclasses only. A discussion of the management of soils in these subclasses follows.

CAPABILITY SUBCLASS VIe, DRYLAND

This subclass consists of nearly level to steep, well-drained to excessively drained, deep and moderately deep soils that are coarse textured to moderately fine textured. The hazard of water and wind erosion ranges from slight to severe.

Available water capacity is 1 to 11 inches. Permeability is slow to rapid. The frost-free period ranges from 110 to 140 days.

These soils are used for range and as wildlife habitat. They are suitable for reseeding, but care must be taken where the soils are severely susceptible to erosion. Gravel pits are in a few areas, and in these places pebbles and channery fragments may be troublesome.

Figure 19.—Crested wheatgrass on Saline wet land. Capability unit VIs–71, irrigated.

CAPABILITY SUBCLASS VIs, DRYLAND

This subclass consists of nearly level to gently sloping, well-drained, deep and moderately deep, medium-textured to fine-textured soils. Some are strongly alkaline. The moderately deep soils are underlain by clay shale or sandstone. The hazards of wind and water erosion are slight to moderate.

Available water capacity is 4 to 11 inches. Permeability is moderately slow to very slow. The frost-free period is 120 to 140 days.

These soils are used for range and as wildlife habitat. They are suitable for reseeding with adapted species.

CAPABILITY SUBCLASS VIw, DRYLAND

This subclass consists of nearly level to gently sloping, wet soils. Some have a saline water table near the surface during most of the growing season.

Because of excess moisture, only water-tolerant plants do well in soils of this unit. The frost-free period is 110 to 140 days.

These soils are used for range and as wildlife habitat. In places drainage is feasible on some of these soils.

CAPABILITY SUBCLASS VIws, DRYLAND

This subclass consists of nearly level to gently sloping soils that have a fluctuating saline water table in the root zone during the growing season. Soluble salts accumulate in the surface layers of these soils. Some areas have patches of salt crust on the surface.

In places these soils contain moisture in excess of plant needs. Permeability above the water table is slow to moderately rapid. The frost-free period is 110 to 140 days.

These soils are used for range and as wildlife habitat. Some areas that have sufficient elevation above the streams can be reclaimed by drainage and leaching.

CAPABILITY SUBCLASS VIIe, DRYLAND

This subclass consists of nearly level to steep, well-drained, shallow, moderately fine textured to coarse-textured soils underlain by clay shale or sandstone. The

hazard of water erosion is moderate to severe, and the hazard of wind erosion is slight to moderate.

Available water capacity is 1 to 3 inches. Permeability is moderately slow or moderately rapid. The frost-free period is 120 to 140 days.

These soils are used for range and as wildlife habitat. They are not suited to reseeding.

CAPABILITY SUBCLASS VIIs, DRYLAND

This subclass consists of nearly level to gently sloping, well-drained, strongly saline and very strongly alkaline, moderately fine textured to moderately coarse textured soils.

Available water capacity is 4 to 7 inches. Permeability is moderately rapid to very slow. The frost-free period is 120 to 140 days.

These soils are used for range and as wildlife habitat. They generally cannot be reclaimed.

CAPABILITY SUBCLASS VIIIe, DRYLAND

Only the land type Gullied land is in this subclass. It is mainly suitable for wildlife habitat and recreation.

CAPABILITY SUBCLASS VIIIw, DRYLAND

Only the land type Marsh is in this subclass. It is covered with water most of the time. This land type can be used for wildlife habitat.

CAPABILITY SUBCLASS VIIIs, DRYLAND

Only the land type Rock land is in this subclass. The areas are steep and rocky and are mainly suitable for wildlife habitat.

Estimated Yields

Table 2 gives estimated yields of the principal irrigated crops grown in the survey area under a high level of management. These estimates are based on observations of the soil scientists who surveyed the area, observations of the soil conservationists of the local Soil Conservation Service work unit, information furnished by farmers of the survey area, and data from the University of Wyoming field testing program in the area. If no information could be obtained for a particular soil, estimates were made on the basis of information pertaining to similar soils. Only soils that are generally used for irrigated crops are included in table 2.

A high level of management provides for adequate tillage, weed and pest control, adequate fertilization, good management of irrigation water, and timeliness of operations.

The cultivation of corn for grain is increasing in the survey area. It has been grown principally on Griffy, Lostwells, and Apron soils. Yield data are scant, but yields of 75 to 120 bushels per acre have been reported.

Management of the Soils for Range[4]

About 248,000 acres of the survey area is range. Most of this is in large areas, and much of it is federally owned.

[4] DURWOOD E. BALL and JIMMY R. BELL, range conservationists, Soil Conservation Service, assisted in preparing this section.

The vegetation is mostly semidesert, grass-shrub plant communities. Production is relatively low, but under good management the areas provide good forage for cattle and sheep. The range is used along with irrigated pasture and hayland. Some of the range is fenced in along with cropland and is used only in winter. Cow-calf, cow-calf-yearling, sheep, and dairying are the major livestock operations. Many horses are wintered in the survey area.

Range sites and condition classes

Range sites are distinctive kinds of range. Each site has its own special combination of soils and climate that enables it to produce a distinctive kind and amount of native vegetation. Each site needs a different kind of management to improve or maintain the desirable plants.

A successful program for improving range requires knowledge of the capabilities of the soils and of management techniques. Each range site has a distinctive potential vegetation. This potential vegetation is the combination of native plants that will grow on a site under the best feasible management practices. The combination of the potential vegetation, in turn, depends on a combination of environmental factors. The vegetation reproduces itself as long as the environment remains the same.

The plants on any given range are grouped, according to their response to grazing, as decreasers, increasers, and invaders. Decreasers are plants of the potential vegetation that tend to die if heavily grazed. Increasers are plants of the potential vegetation that become more abundant as decreasers decline, and then start to die if heavy grazing continues. Invaders are not part of the potential vegetation, but they generally take over under heavy grazing.

As the vegetation of a range site changes from predominantly decreaser to increaser and invader plants, the productivity and general vigor of the range decline. To indicate the degree to which a range has deteriorated from its potential, four classes of range condition are recognized.

A range site is in excellent condition if 76 to 100 percent of the present vegetation is of the same composition as the potential vegetation for the site. Decreaser plants dominate, and forage production is near the maximum for the site.

A range site is in good condition if 51 to 75 percent of the present vegetation is of the same composition as the potential vegetation. A few of the decreaser plants have been replaced by increaser plants, but the general productivity is still good.

A range site is in fair condition if 26 to 50 percent of the present vegetation is of the same composition as the potential vegetation. Because increaser plants are dominant and weedy plants are invading, production of palatable forage is unsatisfactory.

A range site is in poor condition if less than 25 percent of the present vegetation is of the same composition as the potential vegetation. Invaders are abundant, and very few increasers and decreasers remain. Production is very limited.

Descriptions of range sites

The soils of the survey area that produce similar kinds and amounts of vegetation have been grouped

TABLE 2.—*Estimated average yields per acre of principal irrigated crops under a high level of management*

[Absence of yield indicates the crop is not generally grown]

Soil	Sugar beets	Dry beans	Oats	Barley	Alfalfa	Corn for silage
	Tons	*Cwt*	*Bu*	*Bu*	*Tons*	*Tons*
Apron sandy loam, 0 to 3 percent slopes	20	26	90	95	4.0	20
Apron sandy loam, 3 to 6 percent slopes	17	22	90	90	3.5	17
Apron sandy loam, 6 to 10 percent slopes			80	85	3.0	
Apron sandy loam, saline, 0 to 6 percent slopes	16		80	75		
Crowheart loam	16		80	90		
Effington sandy clay loam	16		75	80	3.5	15
Enos-Wall association, gently sloping:						
Enos part					2.0	
Wall part					2.5	
Ethete loam, 0 to 3 percent slopes	20		85	90	5.0	20
Ethete loam, 3 to 6 percent slopes	18		80	85	4.0	17
Ethete loam, saline, 0 to 6 percent slopes	17		80	85		
Fivemile sandy clay loam, 0 to 3 percent slopes	20	20	90	95	5.0	20
Fivemile silty clay loam, 0 to 3 percent slopes	20	18	90	95	5.0	20
Fivemile silty clay loam, 3 to 6 percent slopes	19	17	75	85	4.0	18
Fivemile silty clay loam, saline, 0 to 6 percent slopes	19		80	85		
Glenton sandy loam	20	20	90	95	5.0	20
Griffy loam, 0 to 3 percent slopes	18	25	90	95	4.0	20
Griffy loam, 3 to 6 percent slopes	16	20	85	90	3.5	17
Griffy loam, 6 to 10 percent slopes			80	85	2.5	
Lostwells sandy clay loam, 0 to 3 percent slopes	22	25	90	98	5.0	22
Lostwells sandy clay loam, 3 to 6 percent slopes	20	22	85	90	4.5	20
Lostwells sandy clay loam, 6 to 10 percent slopes			80	85	3.0	
Lostwells sandy clay loam, alkali, 0 to 6 percent slopes	20		85	90	3.0	20
Lostwells sandy clay loam, saline, 0 to 6 percent slopes	20		85	90		
Pavillion sandy clay loam, 0 to 3 percent slopes	19	20	80	85	3.5	19
Pavillion sandy clay loam, 3 to 10 percent slopes	[1] 17	[1] 17	75	80	3.0	[1] 17
Pavillion sandy clay loam, alkali, 0 to 6 percent slopes	17		75	80	3.0	16
Saddle sandy clay loam, 0 to 3 percent slopes	20		85	90	4.0	
Saddle sandy clay loam, 3 to 10 percent slopes			80	85	3.0	
Teapo sandy clay loam, 0 to 3 percent slopes	21	21	85	90	4.0	20
Teapo sandy clay loam, 3 to 6 percent slopes	20	18	80	85	3.0	18
Teapo sandy clay loam, saline, 0 to 6 percent slopes	18		75	80		
Tipperary loamy sand, 0 to 6 percent slopes					3.5	
Trook sandy loam, 0 to 3 percent slopes		20	80	85	4.0	20
Trook sandy loam, 3 to 6 percent slopes		18	75	80	3.5	17
Trook sandy loam, 6 to 10 percent slopes			70	75	3.0	
Trook sandy loam, saline, 0 to 6 percent slopes			70	75		
Winkleman silty clay			75	85	4.0	
Worland sandy loam, 0 to 3 percent slopes	18	23	85	90	3.0	18
Worland sandy loam, 3 to 6 percent slopes	17	21	80	85	2.5	17
Worland sandy loam, 6 to 10 percent slopes			75	80	2.0	
Worland sandy loam, saline, 0 to 6 percent slopes	16		75	80		
Youngston clay loam	20	20	85	90	4.0	20

[1] This crop limited to areas where slope is 3 to 6 percent.

together into 13 range sites. The range sites are listed in their order of natural productivity.

The description of each range site includes estimates of the total annual herbage yields to be expected from that site in excellent condition. These yields are expressed in pounds of air-dry weight of herbage for dry years and moist years.

In this survey area Winkleman silty clay, Winkleman silty clay, saline, and Winkleman silty clay, wet, are not assigned to any range site, nor are the land types Gullied land, Marsh, and Rock land. To find the range site for any given soil refer to the "Guide to Mapping Units," or to the description of that soil.

The scientific and common names of the principal native and introduced plants of the survey area are given in the section "General Nature of the Area."

All the range sites in the survey area are in the 5- to 9-inch precipitation zone.

WETLAND RANGE SITE

This range site consists of poorly drained soils with variably textured surface layers. Slopes are 0 to 6 percent. Annual precipitation is about 9 inches. Permeability and available water capacity are variable. The water table is at or near the surface during most of the growing season.

Decreasers make up 60 to 70 percent of the potential vegetation. They are tall mannagrass, water sedge, beaked sedge, common reedgrass, and Nebraska sedge. Increasers are willows, Baltic rush, inland sedge, golden sedge, and horsetail.

If this site is in excellent condition, it produces an annual yield of about 4,500 pounds of air-dry herbage

per acre. Of this production, 50 to 70 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

SALINE SUBIRRIGATED RANGE SITE

This range site consists of somewhat poorly drained to poorly drained wetland and soils that have a sandy loam to silty clay loam surface layer. Slopes are 0 to 6 percent. Annual precipitation is about 9 inches. Permeability is moderately rapid to very slow. Available water capacity is 2 to 11 inches. The seasonal high water table is at a depth of 0 to 5 feet. The soils are moderately alkaline to very strongly saline (fig. 20).

Decreasers make up 70 to 80 percent of the potential vegetation. They are beardless wildrye, alkali cordgrass, alkali sacaton, and Nuttalls alkaligrass. Increasers are inland saltgrass, western wheatgrass, and alkali bluegrass.

If this site is in excellent condition, it produces a total annual yield of about 2,200 pounds of air-dry herbage per acre in dry years and about 2,500 pounds per acre in moist years. Of this production, 70 to 80 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

LOWLAND RANGE SITE

This range site consists of well-drained soils that have a sandy loam surface layer underlain by stratified deposits of alluvium. Slopes are 0 to 3 percent. Annual precipitation is about 9 inches. Permeability is moderately rapid. Available water capacity is 6 to 7.5 inches. The seasonal high water table benefits woody plants, but it is too low for herbaceous plants.

Decreasers make up 30 to 40 percent of the potential vegetation. These are little bluestem, prairie sandreed, green muhly, Canada wildrye, and slender wheatgrass.

Figure 20.—**Saline Subirrigated range site in excellent condition. The soil is Saline wet land. Nuttals alkaligrass is the dominant grass.**

Increasers are narrowleaf cottonwood, dogwood, Arkansas rose, willows, blue grama, skunkbush, and western virginsbower.

If this site is in excellent condition, it produces about 1,500 pounds of air-dry herbage per acre in dry years and about 2,200 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

One or more of the following practices are practical: seeding, deferred grazing, and planned grazing.

SALINE LOWLAND RANGE SITE

This range site consists of well drained to moderately well drained soils that have variably textured surface layers. Slopes are 0 to 6 percent. Annual precipitation is about 9 inches. Permeability is slow to rapid. Available water capacity is 4 to 11 inches. The soils are very strongly alkaline, and some are strongly saline. The seasonal water table is beneficial to woody plants but is too deep for herbaceous plants (fig. 21).

Decreasers make up 50 to 60 percent of the potential vegetation. These are bottlebrush squirreltail, bud sagebrush, basin wildrye, Gardner saltbush, and western wheatgrass. Increasers are greasewood, Sandberg bluegrass, inland saltgrass, birdfoot sagebrush, and green molley.

If this site is in excellent condition, it produces a total annual yield of about 500 pounds of air-dry herbage per acre in dry years and about 1,000 pounds per acre in moist years. Of this production, 70 to 80 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

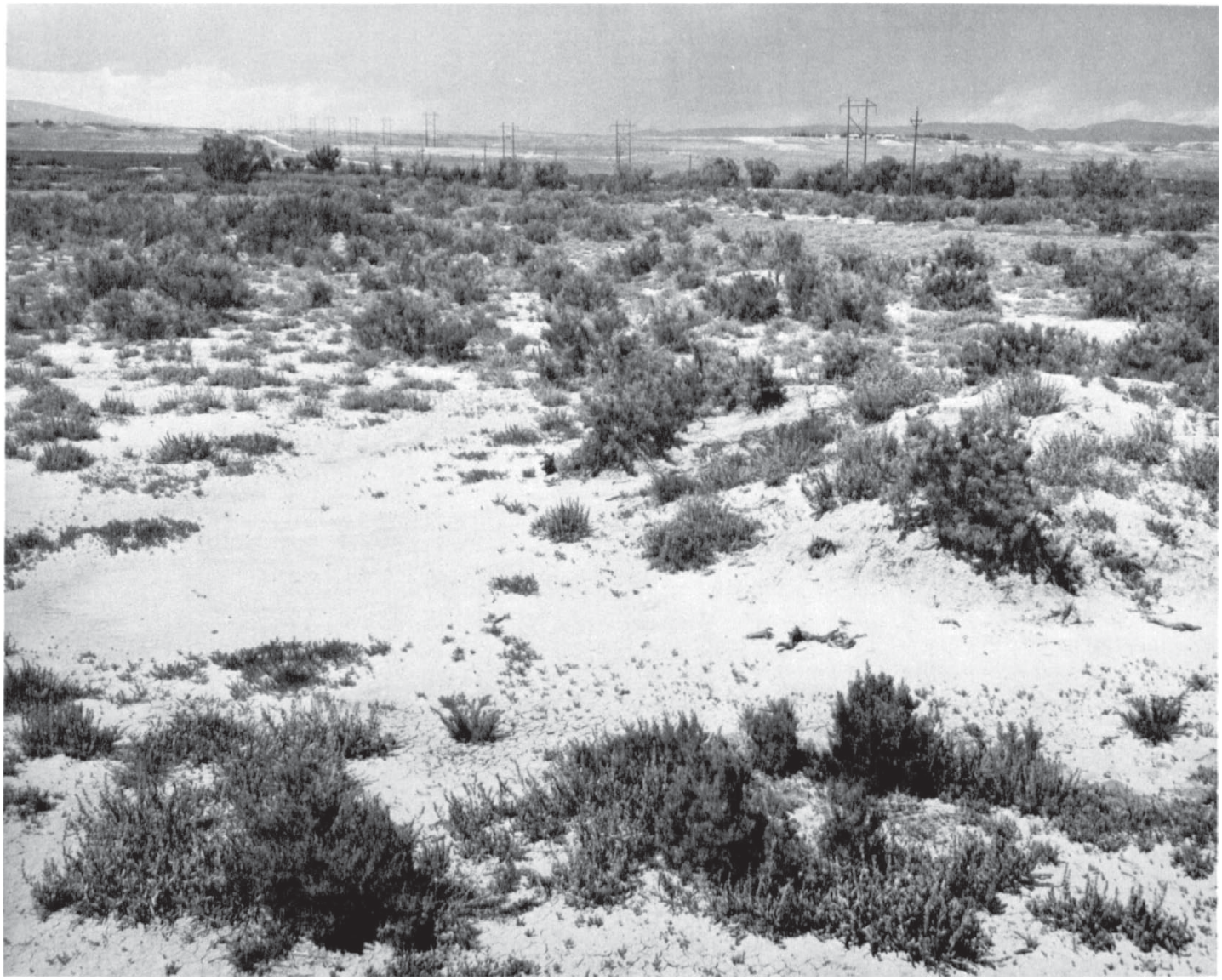

Figure 21.—**Saline Lowland range site in fair condition. The soil is Binton silty clay loam, saline. The dominant vegetation is greasewood and Gardner saltbush.**

SANDS RANGE SITE

This range site consists of excessively drained soils that have a loamy sand surface layer underlain by layers of loamy sand and sand. Slopes are 0 to 20 percent. Annual precipitation is about 9 inches. Permeability is rapid. Available water capacity is 1 to 3 inches.

Decreasers make up 60 to 70 percent of the potential vegetation. They are prairie sandreed, prairie junegrass, Indian ricegrass, and needle-and-thread. Increasers are thickspike wheatgrass, Sandberg bluegrass, blue grama, sand dropseed, Hoods phlox, rubber rabbitbrush, shadscale, and spiny hopsage.

If this site is in excellent condition, it produces about 350 pounds of air-dry herbage in dry years and about 1,000 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

One or more of the following practices are practical: brush control, deferred grazing, and planned grazing.

SANDY RANGE SITE

This range site consists of well-drained soils with a sandy loam or loamy sand surface layer and a sandy loam subsoil or other sandy loam underlying layers. Slopes are 0 to 20 percent. Annual precipitation is about 9 inches. Permeability is moderately rapid. Available water capacity is 2 to 7.5 inches.

Decreasers make up 70 to 80 percent of the potential vegetation. These are prairie junegrass, bottlebrush squirreltail, winterfat, Indian ricegrass, and needle-and-thread. Increasers are rhizomatous wheatgrasses, Sandberg bluegrass, blue grama, red three-awn, big sagebrush, low rabbitbrush, rubber rabbitbrush, shadscale, Hoods phlox, and scarlet globemallow.

If this site is in excellent condition, it produces a total annual yield of about 300 pounds of air-dry herbage per acre in dry years and about 700 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

It is practical to apply one or more of the following practices: seeding, brush control, deferred grazing, and planned grazing.

LOAMY RANGE SITE

This range site consists of well-drained soils that have a loam, sandy clay loam, or sandy loam surface layer underlain by layers of clay loam, sandy clay loam, and silty clay loam. Slopes are 0 to 10 percent. Annual precipitation is about 9 inches. Permeability is moderate and moderately slow. Available water capacity is 3 to 11 inches (fig. 22).

Decreasers make up 40 to 50 percent of the potential vegetation. These are bluebunch wheatgrass, prairie junegrass, winterfat, Indian ricegrass, and needle-and-thread. Increasers are Sandberg bluegrass, blue grama, rhizomatous wheatgrasses, big sagebrush, Hoods phlox, plains pricklypear, and textile onion.

If this site is in excellent condition, it produces a total annual air-dry yield of about 250 pounds per acre in dry years and about 650 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

It is practical to apply one or more of the following practices: seeding, brush control, deferred grazing, and planned grazing.

CLAYEY RANGE SITE

This range site consists of well-drained soils that have a clay loam surface layer underlain by layers of clay loam that are stratified with thin lenses of sandy clay loam, silty clay loam, and sandy loam. Slopes are 0 to 3 percent. Annual precipitation is about 9 inches. Permeability is moderately slow. Available water capacity is 7 to 11 inches.

Decreasers make up 60 to 70 percent of the potential vegetation. These are western wheatgrass, bottlebrush squirreltail, Indian ricegrass, Gardner saltbrush, and bud sagebrush. Increasers are blue grama, Sandberg bluegrass, big sagebrush, upland sedge, forbs, and low rabbitbrush.

If this site is in excellent condition, it produces a total annual yield of about 250 pounds of air-dry herbage per acre in dry years and about 600 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

It is practical to apply one or more of the following practices: seeding, deferred grazing, and planned grazing.

GRAVELLY RANGE SITE

This range site consists of somewhat excessively drained soils that have a gravelly loam surface layer underlain by very gravelly loam. Slopes are 10 to 30 percent. Annual precipitation is about 9 inches. Permeability is moderately rapid. Available water capacity is 3 to 5 inches.

Decreasers make up 30 to 40 percent of the potential vegetation. These are prairie junegrass, needle-and-thread, Indian ricegrass, and bluebunch wheatgrass. Increasers are Sandberg bluegrass, red three-awn, rhizomatous wheatgrasses, big sagebrush, fringed sagewort, and Hoods phlox.

If this site is in excellent condition, it produces a total annual yield of about 200 pounds of air-dry herbage per acre in dry years and about 500 pounds per acre in moist years. Of this production, 70 to 80 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

SHALLOW CLAYEY RANGE SITE

This range site consists of well-drained soils that have a sandy clay loam surface layer underlain by soft shale at depths of 10 to 20 inches. Slopes are 0 to 30 percent. Annual precipitation is about 9 inches. Permeability is moderately slow. Available water capacity is 1 to 3 inches.

Decreasers make up 40 to 50 percent of the potential vegetation. These are Indian ricegrass, bud sagebrush, winterfat, Gardner saltbush, and bottlebrush squirreltail. Increasers are birdfoot sagebrush, Sandberg bluegrass, rhizomatous wheatgrasses, big sagebrush, threadleaf sedge, low rabbitbrush, textile onion, lomatium, and woody aster.

If this site is in excellent condition, it produces a total annual yield of about 150 pounds of air-dry herbage per acre in dry years and about 400 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

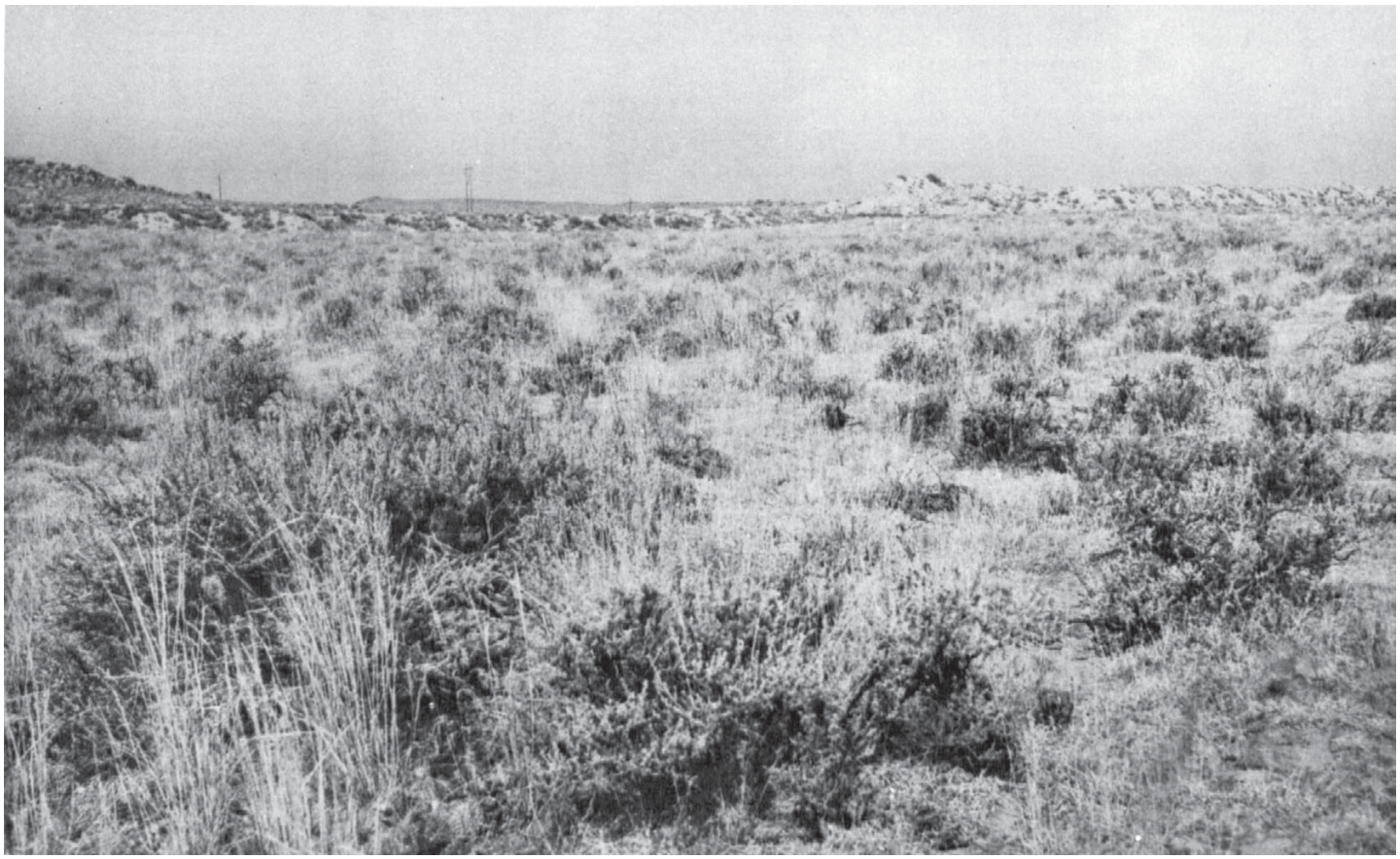

Figure 22.—**Loamy range site in good condition. The soil is Saddle sandy clay loam. Indian ricegrass is the dominant grass. The shrubs are big sagebrush.**

Deferred grazing, planned grazing, or a combination of both types are practical.

SHALLOW SANDY RANGE SITE

This range site consists of well-drained soils that have a sandy loam or loamy sand surface layer. Sandstone or clay shale is at a depth of 10 to 20 inches. Slopes are 10 to 30 percent. Annual precipitation is about 9 inches. Permeability is moderately rapid. Available water capacity is 1 to 2 inches.

Decreasers make up 50 to 60 percent of the potential vegetation. These are prairie junegrass, bluebunch wheatgrass, Indian ricegrass, and needle-and-thread. Increasers are blue grama, threadleaf sedge, needleleaf sedge, shadscale, big sagebrush, rubber rabbitbrush, and Hoods phlox.

If this site is in excellent condition, it produces a total annual yield of about 150 pounds of air-dry herbage per acre in dry years and about 400 pounds per acre in moist years. Of this production, 80 to 90 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

SALINE UPLAND RANGE SITE

This range site consists of well-drained soils that have a sandy clay loam and silty clay loam surface layer underlain by layers of sandy clay loam or silty clay loam. Slopes are 0 to 6 percent. Annual precipitation is about 9 inches. Permeability is moderately slow to very slow. Available water capacity is 4 to 11 inches. Some of the soils are strongly alkaline.

Decreasers make up 70 to 80 percent of the potential vegetation. These are Gardner saltbush, bottlebrush squirreltail, Indian ricegrass, and bud sagebrush. Increasers are rhizomatous wheatgrasses, Sandberg bluegrass, birdfoot sagebrush, plains pricklypear, and woody aster.

If this site is in excellent condition, it produces a total annual yield of about 150 pounds of air-dry herbage per acre in dry years and about 350 pounds per acre in moist years. Of this production, 60 to 70 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

ALKALI UPLANDS RANGE SITE

This range site consists of well-drained soils that have a sandy clay loam and clay loam surface layer underlain by layers of sandy clay loam, clay loam, and clay. Slopes are 0 to 10 percent. Annual precipitation is about 9 inches. Permeability is slow to very slow. Available water capacity is 1 to 9 inches. The soils are strongly and very strongly alkaline.

Decreasers make up 30 to 40 percent of the potential vegetation. These are Indian ricegrass, Gardner saltbush, bottlebrush squirreltail, and rhizomatous wheatgrasses. Increasers are birdfoot sagebrush, Sandberg bluegrass, loamatium, and textile onion.

If this site is in excellent condition, it produces a total annual yield of about 100 pounds of air-dry herbage per acre in dry years and about 300 pounds per acre in moist years. Of this production, 50 to 70 percent is suitable as forage for cattle or sheep.

Deferred grazing, planned grazing, or a combination of both types are practical.

Management of the Soils for Windbreaks

Native woody plants other than woody shrubs are mostly confined to the bottom lands along the Wind River and to the side slopes of Wind River Canyon. The trees along the Wind River are mainly cottonwood, willow, and scattered juniper. The trees in Wind River Canyon are scrubby juniper. Scattered patches of cottonwood and willow grow along Fivemile and Muddy Creeks, but these trees appeared when irrigation began. None of the timber in the Area is commercial.

The soils of the survey area vary widely in their suitability for trees. Soils range from sands to silty clays. Most soils are sandy loams or sandy clay loams. Many of them are underlain by sandstone, shale, or gravel at a depth of 10 to 40 inches. Many soils are limited by wetness, salinity, alkalinity, or a combination of these. Where alkalinity is the limitation, trees don't grow well in shelterbelts. Where salinity is not too high, some trees can be grown; but where salinity is high, trees do not grow well. A water table close to the surface prevents the growth of most trees. Where bedrock or clean gravel is close the surface, most tree growth is severely limited. In places tree stands are difficult to establish on sands or silty clays. On some soils the hazard of wind erosion is severe if there is no vegetative cover through winter. During some winters, drifting snow may damage farmsteads or be a hazard to livestock. Because of these conditions, windbreaks to protect fields, farmsteads, and feedlots are beneficial and are needed on most farms.

In 1957, a study was made by A. L. Ford and J. L. McWilliams, Soil Conservation Service, concerning tree growth in windbreaks in the survey area. This study pointed out that caragana, Chinese elm, Russian-olive, and golden willow were the best suited species. Other species not used extensively but that showed considerable promise were chokecherry, cottonwood, Tartarian honeysuckle, white willow, and American elm. Chinese elm and Russian-olive are the species best adapted to saline soils. No species studied was satisfactory where soil salinity is high and soil drainage is poor.

To establish a windbreak successfully, it is necessary to eliminate other vegetation and to prepare the site for tree planting. Hardy stock should be selected. After the trees are planted, they should be cultivated to prevent competition from weeds and grass. Protection from fire and grazing is needed. Trees also need additional moisture from irrigation until they become established. To be most effective a windbreak should contain three or more rows of trees.

Windbreak suitability groups

The soils of the survey area have been placed in three windbreak suitability groups. These groups were determined from a study of windbreaks made in 1957 and from field experience of technicians working in the Area. Given for each windbreak suitability group are the trees and shrubs suited to the group and the soil-management practices required for the group. For the placement of each soil in its windbreak suitability group, refer to the "Guide to Mapping Units" at the back of this survey.

WINDBREAK SUITABILITY GROUP I

This group consists of well-drained, moderately deep to deep sandy clay loams, clay loams, loams, and silty clay loams. These soils are moderately alkaline and are free of excess soluble salts. Slopes range from 0 to 10 percent. Once they are established, trees grow well on these soils.

The management of these soils requires clean cultivation the first 4 or 5 years. For the first year, at least one irrigation every month is needed during the growing season; during the second and third years, one every 6 weeks; during the fourth and fifth years, one every 2 months; and two irrigations each year thereafter. The first irrigation should be applied as soon as water is available, and the second in July.

Chemical weed control with adapted chemicals may be necessary, and the chemicals should be applied according to the directions of a specialist. Weeds are likely to be more of a hazard on these soils than on the soils of group II.

The species adapted to soils of this group are—

Tall trees	*Shrubs*	*Evergreens*
Siberian elm	Russian-olive	Ponderosa pine
Cottonless cottonwood	Lilac	Austrian pine
Golden willow	Squawbush	Rocky Mountain juniper
White willow	Chokecherry	Colorado blue spruce
Diamond willow	American plum	
Green ash		

WINDBREAK SUITABILITY GROUP II

This group consists of well-drained to excessively drained, moderately deep to deep sandy loams, loamy sands (fig. 23), channery loams, and gravelly loams. These soils are moderately alkaline in reaction. Excessive soluble salts are not a concern when managing these soils for trees. Slopes range from 0 to 10 percent. Once they are established, trees grow well on these soils.

The hazards of wind and water erosion are slight to severe. Seeding cover crops between the rows is recommended until the trees are six feet or more in height. For the first year one irrigation each twenty days is needed. During the second and third years, one irrigation each month is adequate. During the fourth and fifth years, irrigation is needed once every six weeks, and once every eight weeks is adequate thereafter. Irrigation should begin as early in the season as water is available. The trees should be irrigated after they have lost their leaves if water is available at this time. Weeds are not as serious a problem on these soils as on the soils in group I.

The species adapted to soils of this group are—

Tall trees	*Shrubs*	*Evergreens*
Siberian elm	Russian-olive	Ponderosa pine
Cottonless cottonwood	Lilac	Austrian pine
Golden willow	Squawbush	Rocky Mountain juniper
White willow	Chokecherry[4]	Colorado blue spruce
Diamond willow	American plum	
Green ash	Honeysuckle	
	Sand cherry	

WINDBREAK SUITABILITY GROUP III

The soils in this group have limited suitability for trees. Among the unfavorable characteristics are strong alkalinity, slight to moderate salinity, and a fluctuating water table. Other frequent unsuitable characteristics are depth, texture, slope, and droughtiness. In places the limitations can be overcome by drainage, soil amendments, or mechanical treatments. Each site should be checked before trees are planted. Assistance can be obtained from the Riverton Soil Conservation Service field office. Trees, however, are not expected to grow as well on these soils as on soils of groups I and II. Species selected need to be those that can grow in spite of alkalinity, salinity, or other limitation of the particular soil on which they will be planted.

Management of the Soils for Wildlife [5]

The number and kinds of wildlife in the survey area and elsewhere are determined by the kinds and amounts of vegetation and by land use, both of which are influenced by fertility of the soils, by irrigation, by topography, and by the kinds and intensity of farming. Fertile soils are capable of supporting larger wildlife populations than are soils of low fertility. Topography affects the wildlife population because it affects the land use, including grazing practices, and the kinds of crops produced. The extent of grazing and amount of vegetation left in the

[5] L. M. Moos, biologist, Soil Conservation Service, assisted in preparing this section.

Figure 23.—Farmstead windbreak on Tipperary loamy sand, 0 to 6 percent slopes.

fall are important in determining the survival of many wildlife populations through the winter, which is the critical period for most species.

The kind of soil and the level of the water table are important in determining the number and kinds of wildlife. The level of the water table determines the presence of natural water areas such as marshes and seeps. Soil characteristics must be considered when planning water developments for fish, waterfowl, and other water-dependent species. Topography and soil characteristics determine where wildlife and fish ponds can be developed. Ponds that have steep shorelines and impervious soils are required for fish, and shallow basins that have gradually sloping shorelines are required for waterfowl.

Where natural water areas exist, they should be protected from grazing and maintained or improved as aquatic and marsh habitat for waterfowl, furbearers, and other kinds of water-dependent wildlife.

The soils and their vegetation provide habitat for many kinds of wildlife in the survey area. Important game species include chukars, cottontail rabbits, ducks, geese, pheasants, and some sage grouse. A few antelope live in the Tipperary-Trook and Apron-Trook associations. Some mule deer and beaver inhabit areas in the Crowheart-Bigwin association. Raccoons live around water areas in all associations.

Boysen Reservoir, the largest water area, has a large number of walleyed pike, bass, crappie, ling, and rainbow trout. Ling provide winter fishing. Ocean Lake has many crappies, some largemouth bass, and ling. Cameahwait Lake, which is about 600 acres in size, has a large number of largemouth bass, silver salmon, and rainbow trout. Pilot Butte, an irrigation reservoir, has a severe drawdown that lessens its value as a fishery. There is some fishing for ling in winter, but the reservoir is not regularly stocked. Although trout grow very rapidly in the waters of the survey area, they do not reproduce. Consequently, a continual stocking program is required.

Waterfowl migrate through the survey area in large numbers in spring and fall. Some mallards, teal, shovelers, redheads, and Canada geese remain to nest. Artificial nesting boxes for geese at Ocean, Kinnear, and Cameahwait Lakes attract and hold Canada geese for nesting.

Ocean Lake is a waterfowl development project of the Wyoming Game and Fish Department. Food and cover plants are grown there for waterfowl and pheasants. Establishment of a nesting colony of Trumpeter swans is being attempted there.

Pheasants, the most important game bird, inhabit the irrigated part of the survey area, generally in the Apron-Lostwells associations.

Management to improve habitat for pheasants includes providing cover, travel lanes, and nesting places by protecting windbreaks, fence rows, ditchbanks, marshes, and odd areas from burning and grazing; leaving strips of corn or other grains near existing cover so that food and cover are not more than one-fourth mile apart; and providing special plantings of winter food, including the choice foods barley, corn, and wheat.

Chukars inhabit areas with rough topography, especially in the Persayo-Oceanet soil association.

Sites suitable for fish ponds are limited because a depth of 10 feet is required. The areas where water can be impounded for waterfowl are numerous. The Birdsley-Effington-Boysen association is best adapted for impoundments. Waterfowl areas require water only 1 to 3 feet deep where its supply is constant. Shorelines should be protected from grazing to provide nesting sites. Planting barley or wheat and flooding the ripe grain before the hunting season attracts waterfowl for hunting.

Antelope are only in the Tipperary-Trook and Apron-Trook associations. These are dry areas that have a large percentage of sagebrush in the vegetation. The absence of water limits the distribution of antelope in these associations, and the possibility of water developments also is limited. Choice food for antelope includes aster, comandra, yellow fritillaria, prickly lettuce, rubber rabbitbrush, sagebrush, Gardner saltbush, snowberry, and springbeauty.

Predators in the area include coyotes, red fox, skunks, raccoons, eagles, owls, hawks, crows, and magpies. These are an important part of the wildlife of the survey area, because they do not materially reduce the number of game birds but help control rodents, if good cover and food are properly spaced.

Songbirds and insectivorous birds are numerous in the survey area, especially during the nesting season. The habitat for these desirable birds can be improved by protecting the existing woody cover, planting additional trees and shrubs, managing fence rows, and developing odd areas.

Furbearers include beaver, mink, and some muskrat. Beaver are limited to the area along Wind River. Muskrats are around Ocean Lake and along the larger drain ditches. By protecting ditches from heavy grazing, the habitat for muskrats is improved.

Engineering Uses of the Soils [6]

In this section two systems of classifying soils for engineering are described, properties of soils significant in engineering are estimated, the soils are interpreted for engineering uses, and laboratory test data of selected soils are listed.

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, water-storage facilities, erosion-control structures, irrigation and drainage systems, and sewage-disposal systems. The properties most important to the engineer are permeability, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain size, plasticity, and reaction (pH). Topography and depth to the water table and to bedrock also are important.

Engineers can use the information in this publication to:

1. Make studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Plan the construction of drainage systems, farm ponds, irrigation systems, and other soil and water conservation structures.
3. Make preliminary evaluations of soils in selecting locations for highways, airports, pipelines, cables, and buildings, and in planning detailed

[6] DAVID J. TOKACH, engineer, Soil Conservation Service, assisted in preparing this section.

soil investigations at the selected locations.
4. Locate sources of sand, gravel, and other construction material.
5. Correlate performance of engineering structures with soil mapping units and thus develop information for planning that will be useful in designing and maintaining such structures.
6. Determine the suitability of various soils for cross-country movement of vehicles and construction equipment.
7. Supplement information from other sources and make engineering maps and reports.
8. Develop other preliminary estimates for construction purposes pertinent to a specific area.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized, however, that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for indicating the kinds of problems that can be expected.

Most of the information in this section is given in table 3, "Estimated Soil Properties Significant to Engineering," table 4, "Interpretations of Engineering Properties of the Soils," and table 5, "Engineering Test Data."

Some of the terms used in this publication have special meanings in soil science that do not correspond with the meanings of the same terms in engineering. These terms are defined in the Glossary according to their meanings in soil science.

Engineering classification systems

Two systems of soil classification are in general use by engineers. They are the system used by the American Association of State Highway Officials (*1*) and the Unified system used by the U.S. Department of Defense (*11*). Estimated classifications of all the soils according to these two systems and according to the textural classification used by the U.S. Department of Agriculture (*8*) are shown in table 3. The two engineering classification systems are explained in a publication of the Portland Cement Association (*4*) and are discussed briefly here.

The American Association of State Highway Officials (AASHO) has developed a classification system based on field performance and on gradation, liquid limit, and plasticity index. In this system soils are placed in seven groups ranging from A–1 through A–7. Soils in the A–1 group are gravelly and have high shear strength; those in the A–7 group are clayey and have low shear strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number ranging from 0 for the best material to 20 for the poorest. The group index numbers are in parentheses and are shown only in the test data in table 5.

The Unified system, developed by the Waterways Experiment Station, Corps of Engineers, and adopted by the U.S. Department of Agriculture, is based on the texture and plasticity of soils, as well as their performance. Three soil fractions are recognized—gravel, sand, and fines (silt and clay). Soils are classified as coarse grained (eight classes), fine grained (six classes), and highly organic (one class) according to their content of the three soil fractions. A letter symbol indicates the principal characteristic of the soils. The coarse-grained soils are gravel (G) and sand (S), and each of these is divided into four secondary groups. Fine-grained soils are subdivided into silt (M) and clay (C), depending on liquid limit and plasticity index. The silt and clay groups are each divided into secondary groups according to whether the soils have low (L) or high (H) liquid limit. The highly organic soils, such as peat and muck, are generally highly compressible and have undesirable construction characteristics. They are placed in one group designated by the symbol Pt.

Estimated engineering properties of the soils

Table 3 contains estimates of soil properties and qualities significant in engineering. The estimates are given for soils of each series. Estimates of percentages passing sieves were based on test data, if available, and on the USDA textural classification. Some of the soil properties and qualities referred to in table 3 are defined in the following paragraphs.

Permeability is the quality of a soil that enables water or air to move through it. It is expressed as the rate at which water percolates through undisturbed soil and is measured in inches per hour. Permeability is important because it affects the settlement rate of structures and the performance of drainage systems and sewage disposal fields.

Available water capacity is the amount of soil water that is available for plant growth. Available water capacity must be considered in planning irrigation. It is defined in more detail in the Glossary.

Soil reaction is the acidity or alkalinity of the soil, expressed in pH values. The lower values indicate acidity, and the higher values, alkalinity. Reaction is defined in more detail in the Glossary.

Salinity is the soluble salt content of the soil. Salinity affects the suitability of soils for crops, the stability of the soil if used as construction material, and the corrosivity of the soil to concrete or steel.

Shrink-swell potential is the change in volume that can be expected as the moisture content of a soil changes. The estimates are based on kind and amount of clay in the soil. Fine-textured soils generally have a high shrink-swell potential; coarse-textured soils have a low shrink-swell potential.

Corrosivity, as used here, indicates the potential danger to uncoated steel or concrete structure through chemical action that dissolves or weakens the structural material. Structural materials may corrode if buried in soil, and a given material corrodes in some kinds of soil more rapidly than in others.

Engineering interpretations of the soils

In table 4 the soil series are rated according to their suitability as construction material, and soil features that affect specified engineering structures and practices are given. In the following paragraphs the column heads and some important soil features in table 4 are described.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily rich in organic matter, used as a

TABLE 3.—*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 soils in referring to other series that appear in the first column of this table.

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHO
	In	*Ft*	*In*			
Apron: ApA, ApB, ApC, ArB, AsB, AtB, AuB.	(2)	(3)	0–60	Sandy loam	SM	A–2 or A–4
Bigwin: Bg	(2)	3–5	0–30 30–60	Sandy loam Sand and gravel	SM GW	A–2 A–1
Binton: Bm, Bn	(2)	(3)	0–60	Silty clay loam	CL	A–7
*Birdsley: BoC, BRC, BSC For Boysen part of BRC, see Boysen series. For Meeteetse part of BRC, see Meeteetse series, sandy clay loam. For Pavillion part of BRC and BSC, see Pavillion series. For Apron part of BSC, see Apron series.	10–20	(3)	0–12 12	Clay loam Clay shale.	CL	A–6
Boysen: ByB	(2)	(3)	0–60	Sandy clay loam	SC or CL	A–6
*Clifterson: CgE, CHE, CRF Rock land part of CRF, too variable to be rated. For Oceanet part of CRF, see Oceanet series. For Persayo part of CRF, see Persayo series.	(2)	(3)	0–60	Very channery loam or very gravelly loam.	GM	A–1
Crowheart: Cw	(2)	3–5	0–10 10–30 30–60	Loam Fine sandy loam Sand and gravel	CL or ML SM GW	A–4 or A–6 A–4 A–1
*Effington: Ef, En, EP For Apron part of EP, see Apron series.	(2)	(3)	0–5 5–17 17–60	Sandy clay loam Clay Sandy clay loam	SC or CL CH SC or CL	A–6 A–7 A–6
Eg	(2)	(3)	0–5 5–17 17–27 27–60	Sandy clay loam Clay Sandy clay loam Sand and gravel	SC or CL CH SC or CL GW	A–6 A–7 A–6 A–1
*Enos: ESB For Wall part of ESB, see Wall series. For Oceanet part of ESB, see Oceanet series. Rock land part of ESB too variable to be rated.	20–40	(3)	0–34 34	Sandy loam and loamy sand Sandstone.	SM	A–2
Ethete: EtA, EtB, EuB	(2)	(3)	0–34 34–60	Clay loam Sand and gravel	CL GW	A–6 A–1
Fivemile: FmA, FnA, FnB, FoB	(2)	(3)	0–60	Silty clay loam. (Sandy clay loam surface in FmA.)	CL	A–7
Fruita: FrA, FrB	(2)	(3)	0–60	Clay loam	CL	A–6 or A–7
Glenton: Gn	(2)	(3)	0–60	Sandy loam	SM	A–2 or A–4
Griffy: GrA, GrB, GrC	(2)	(3)	0–15 15–60	Sandy clay loam Fine sandy loam	SC or CL SM	A–4 A–4
Gullied land: Gu. Too variable to be rated.						
Lostwells: LoA, LoB, LoC, LsB, LtB	(2)	(3)	0–60	Sandy clay loam	SC or CL	A–4 or A–6
Marsh: Ma. Too variable to be rated.						

See footnotes at end of table.

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for
The symbol < means less than; the symbol > means more than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction (1:5 dilution)	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel [1]	Concrete
				In/hr	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*			
95–100	90–100	80–100	30–45	2. 0–6. 3	0. 11–0. 13	7. 9–9. 6	0–8	Low	High	Moderate to high.
90–100	85–95	75–85	25–35	2. 0–6. 3	0. 11–0. 13	7. 9–8. 4	0–4	Low	High	Low.
[4] 40–50	35–45	15–25	0–5	6. 3–20. 0	0. 03–0. 05	7. 9–8. 4	0–4	Low	High	Low.
95–100	95–100	95–100	80–95	0. 06–0. 2	0. 07–0. 09	8. 5–9. 6	0>15	Moderate	High	High.
95–100	95–100	90–100	70–80	<0. 06	0. 07–0. 09	9. 1–9. 6	0–4	Moderate	High	High.
95–100	95–100	80–90	35–55	<0. 06	0. 07–0. 09	9. 1–9. 6	0–4	Moderate	High	High.
[4] 40–50	30–40	20–30	15–25	2. 0–6. 3	0. 05–0. 09	7. 9–8. 4	0–4	Low	High	Low.
[4] 85–100	85–95	80–90	60–75	0. 6–2. 0	0. 16–0. 18	9. 1–9. 4	4–8	Low	High	High.
[4] 85–100	85–95	60–70	35–50	2. 0–6. 3	0. 13–0. 15	7. 9–9. 0	4–8	Low	High	Moderate.
[4] 40–50	20–30	5–10	0–5	6. 3–20. 0	0. 03–0. 05	7. 9–9. 0	0–4	Low	High	Moderate.
95–100	95–100	80–90	35–55	0. 2–0. 6	0. 07–0. 09	8. 5–9. 0	8–15	Moderate	High	High.
95–100	95–100	75–85	70–80	0. 06–0. 20	0. 07–0. 09	9. 1–9. 6	8–15	High	High	High.
95–100	90–100	75–85	35–55	0. 2–0. 6	0. 07–0. 09	9. 1–9. 6	8–15	Moderate	High	High.
95–100	95–100	80–90	35–55	0. 2–0. 6	0. 07–0. 09	8. 5–9. 0	8–15	Moderate	High	High.
95–100	95–100	75–85	70–80	0. 06–0. 20	0. 07–0. 09	9. 1–9. 6	8–15	High	High	High.
95–100	90–100	75–85	35–55	0. 2–0. 6	0. 07–0. 09	9. 1–9. 6	8–15	Moderate	High	High.
40–50	20–30	5–10	0–5	6. 3–20. 0	0. 03–0. 05	7. 9–9. 0	8–15	Low	High	Moderate.
95–100	90–100	70–85	15–25	2. 0–6. 3	0. 10–0. 12	7. 0–8. 4	0–4	Low	High	Low.
90–100	85–100	80–95	60–75	0. 6–2. 0	0. 16–0. 18	7. 4–9. 0	0–8	Moderate	High	Moderate.
30–45	15–25	10–20	0–5	6. 3–20. 0	0. 03–0. 05	7. 9–9. 0	0–4	Low	High	Moderate to high.
95–100	95–100	95–100	80–95	0. 2–0. 6	0. 18–0. 20	7. 9–9. 0	0–8	Moderate	High	High.
95–100	75–100	70–90	60–80	0. 2–0. 6	0. 12–0. 15	8. 5–9. 0	0–4	Moderate	High	High.
95–100	90–100	60–70	30–45	2. 0–6. 3	0. 11–0. 13	7. 9–8. 4	0–4	Low	High	Low.
95–100	95 100	85–95	45–55	0. 6–2. 0	0. 14–0. 16	7. 4–8. 4	0–4	Moderate	High	Low.
80–100	55–95	50–80	35–45	2. 0–6. 3	0. 10–0. 15	7. 9–9. 0	0–4	Low	High	H gh.
95–100	95–100	80–90	45–55	[5] 0. 2–0. 6	0. 11–0. 16	7. 9–9. 0	0–8	Moderate	High	Low to moderate.

TABLE 3.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHO
	In	*Ft*	*In*			
*Meeteetse: MdB and loamy sand part of MEB	(2)	(3)	0–20 20–38 38–60	Loamy sand Clay Clay loam	SM CH CL	A–2 A–7 A–6
Sandy clay loam part of MEB. For Mudray part of MEB, see Mudray loamy sand. For Birdsley part of MEB, see Birdsley series. For Boysen part of MEB, see Boysen series.	(2)	(3)	0–18 18–60	Clay Clay loam	CH CL	A–7 A–6
Mudray: MmB, MtB. For Meeteetse part of MmB, see Meeteetse series, loamy sand. For Meeteetse part of MtB, see Meeteetse series, sandy clay loam.	10–20	(3)	0–17 17	Sandy clay loam. (Loamy sand surface layer in MmB) Clay shale.	SC or CL	A–6
*Oceanet: OcC, ORE. Rock land part of ORE too variable to be rated.	10–20	(3)	0–14 14	Sandy loam Sandstone.	SM	A–2
Pavillion: PaA, PaC, PcB	20–40	(3)	0–32 32	Sandy clay loam Clay shale.	SC	A–4
*Persayo: PeE, POD, PRE. For Oceanet part of POD and PRE, see Oceanet series. Rock land part of POD too variable to be rated. For Worland part of PRE, see Worland series.	10–20	(3)	0–14 14	Sandy clay loam Clay shale.	SC or CL	A–6
Rock land: RS. Too variable to be rated.						
Saddle: SaA, SaC	20–40	(3)	0–30 30	Sandy clay loam Clay shale.	SM	A–4
Saline wet land: Sw. Too variable to be rated.						
Teapo: TcA, TcB, TeB	20–40	(3)	0–30 30	Sandy clay loam Clay shale.	SC or CL	A–4 or A–6
Tipper [7]	20–40	(3)	0–26 26	Loamy sand Sandstone.	SM	A–2
*Tipperary: TmB, TmC, TnD, TOE, TRE. For Tipper part of TOE, see Tipper series. For Oceanet part of TOE and TRE, see Oceanet series. For Trook part of TRE, see Trook series. For Persayo part of TRE, see Persayo series.	(2)	(3)	0–60	Loamy sand and sand	SM	A–2
*Trook: TsA, TsB, TsC, TtB, TUB, TVD. For Apron part of TUB and TVD, see Apron series. For Clifterson part of TVD, see Clifterson series. For Persayo part of TVD, see Persayo series.	(2)	(3)	0–27 27–60	Sandy loam Gravelly sandy loam	SM SM	A–2 A–1
Wall [8]	(2)	(3)	0–60	Sandy loam and loamy sand	SM	A–2
Wet alluvial land: Wa. Too variable to be rated.						

See footnotes at end of table.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction (1:5 dilution)	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel [1]	Concrete
				In/hr	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*			
95–100	95–100	50–60	15–25	6. 3–20. 0	0. 06–0. 08	7. 9–8. 4	0–4	Low	High	Low.
95–100	95–100	80–90	70–80	0. 06–0. 20	0. 07–0. 09	9. 1–9. 8	0–4	High	High	High.
100	95–100	75–85	60–70	0. 2–0. 6	0. 11–0. 14	9. 1–9. 8	0–4	Moderate	High	High.
95–100	95–100	80–90	70–80	0. 06–0. 20	0. 07–0. 09	9. 1–9. 8	0–4	High	High	High.
100	95–100	75–85	60–70	0. 2–0. 6	0. 11–0. 14	9. 1–9. 8	0–4	Moderate	High	High.
90–100	90–100	80–90	45–55	0. 06–0. 20	0. 07–0. 09	8. 5–9. 8	0–4	Moderate	High	High.
90–100	90–100	60–70	25–35	2. 0–6. 3	0. 11–0. 13	7. 9–8. 4	0–4	Low	High	Low.
95–100	95–100	75–85	35–50	[6] 0. 6–2. 0	0. 11–0. 16	7. 9–9. 0	0–4	Moderate	High	Moderate.
95–100	95–100	85–95	45–55	0. 2–0. 6	0. 14–0. 16	7. 9–9. 0	0–4	Moderate	High	Moderate.
95–100	95–100	85–95	30–40	0. 6–2. 0	0. 14–0. 16	7. 0–9. 0	0–4	Moderate	High	Low to moderate.
95–100	95–100	80–90	45–55	0. 6–2. 0	0. 14–0. 16	7. 9–8. 4	0–8	Moderate	High	Low to moderate.
95–100	95–100	50–75	15–25	6. 3–20. 0	0. 06–0. 08	7. 9–9. 0	0–4	Low	High	Low to moderate.
90–100	90–100	50–75	15–25	6. 3–20. 0	0. 06–0. 08	7. 9–9. 6	0–4	Low	High	Low to high.
90–100	90–100	60–70	25–35	2. 0–6. 3	0. 11–0. 13	7. 9–9. 0	0–8	Low	High	Moderate.
55–80	50–75	30–50	15–25	6. 3–20. 0	0. 08–0. 10	8. 5–9. 0	0–8	Low	High	Moderate.
95–100	95–100	50–75	15–25	2. 0–6. 3	0. 06–0. 08	7. 4–8. 4	0–4	Low	High	Low.

TABLE 3.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHO
	In	*Ft*	*In*			
Winkleman: Wc, We, Wk	(2)	(3)	0–60	Silty clay	CH	A–7
*Worland: WoA, WoB, WoC, WrB, WSC—For Oceanet part of WSC, see Oceanet series. Rock land part of WSC too variable to be rated.	20–40	(3)	0–30 30	Sandy loam Sandstone.	SM	A–2 or A–4
Youngston: Yo	(1)	(2)	0–60	Clay loam	CL	A–6

[1] Uncoated steel corrosion classes for conductivity in millimhos per centimeter are *low*, less than 0.2; *moderate*, 0.2 to 0.4; *high*, more than 0.4.

[2] No bedrock to depth of profile, normally 5 feet.

[3] No water table observed to depth of profile, normally 5 feet, except in AtB (2 to 4 feet), AuB (0 to 1 foot), En (0 to 1 foot), EuB (3 to 5 feet), LtB (3 to 5 feet), TeB (2 to 4 feet), TtB (3 to 5 feet), We (3 to 5 feet), Wk (0 to 1 foot), and WrB (2 to 4 feet).

TABLE 4.—*Interpretations of*

[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 soils in referring to other series that appear

Soil series and map symbols	Suitability as source of—			Degree and kind of limitations for—		
	Topsoil	Sand and gravel	Road fill	Local roads and streets	Dwellings without basements	Shallow excavations
Apron: ApA, ApB, ApC, ArB, AsB, AtB, AuB.	Good for ApA, ApB, ApC; only uppermost 30 inches of AsB is suitable; ArB, AtB, and AuB are unsuitable because of alkali, salts, and high water table.	Poor for sand; no gravel.	Good to fair: A–2 and A–4 material.	Moderate: fair to good subgrade; mostly good drainage, but AtB and AuB have somewhat poor to poor drainage.	Slight except that AuB has severe limitation because of water table at depth of 0 to 1 foot and AtB has moderate limitation because of water table at depth of 2 to 4 feet.	Slight except that AtB has moderate limitation and AuB has severe limitation because of water table.
Bigwin: Bg	Good above gravel.	Poor for sand; good for gravel below depth of 30 inches.	Good	Moderate: somewhat poor drainage.	Slight	Moderate: water table at depth of 3 to 5 feet.
Binton: Bm, Bn	Unsuitable: salts and alkali.	Unsuitable: excessive fines.	Poor: A–7 material.	Severe: A–7 material.	Moderate: moderate shrink-swell potential.	Slight

See footnotes at end of table.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction (1:5 dilution)	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel [1]	Concrete
				In/hr	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*			
95–100	85–100	85–95	80–90	0. 06–0. 2	0. 12–0. 17	7. 9–9. 0	0–8	High	High	Moderate to high.
95–100	90–100	60–70	30–45	2. 0–6. 3	0. 11–0. 13	7. 9–8. 4	0–8	Low	High	Low to high.
95–100	95–100	80–95	70–80	0. 2–0. 6	0. 18–0. 20	7. 9–8. 4	0–4	Moderate	High	Low.

[4] Cobblestones discarded before sieving.
[5] 0.06–0.20 in/hr in LsB.
[6] 0.2–0.6 in/hr in PcB.
[7] Tipper soil mapped only as a part of the Tipperary-Tipper association.
[8] Wall soil mapped only as a part of the Enos-Wall association.

engineering properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Degree and kind of limitations for—			Soil features affecting—			Hydrologic soil groups
Septic-tank absorption fields	Sewage lagoons	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	
Slight except that AtB and AuB have severe limitations of high water table.	Severe for ApA, ApB, ApC, ArB, and AsB because of moderately rapid permeability; severe for AtB and AuB because of high water table.	Moderately rapid permeability; AtB and AuB have high water table.	High piping hazard; medium shear strength; medium to low permeability if compacted.	Moderately rapid permeability; subsurface drainage possible.	Moderate intake rate; high available water capacity; good subdrainage; AtB and AuB have high water table.	B for ApA, ApB, ApC, ArB, and AsB; C for AtB; and D for AuB.
Severe: water table at depth of 3 to 5 feet may contaminate water supply.	Moderate: water table at depth of 3 to 5 feet.	Moderately rapid permeability.	Medium to low piping hazard; medium to high permeability if compacted.	Outlets difficult to locate.	Moderately rapid intake rate; low available water supply.	B if drained; C if not drained.
Severe: slow permeability.	Slight	Slow permeability.	Medium to low shear strength and piping hazard; low permeability if compacted.	Slow permeability.	Slow permeability.	C

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as source of—			Degree and kind of limitations for—		
	Topsoil	Sand and gravel	Road fill	Local roads and streets	Dwellings without basements	Shallow excavations
*Birdsley: BoC, BRC, BSC—For Boysen part of BRC, see Boysen series. For Meeteetse part of BRC, see Meeteetse series. For Pavillion part of BSC, see Pavillion series. For Apron part of BSC, see Apron series.	Unsuitable: alkali.	Unsuitable: excessive fines.	Poor: A–6 material.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: soft bedrock at depth of 10 to 20 inches.
Boysen: ByB	Unsuitable: alkali.	Unsuitable: excessive fines.	Poor: A–6 material.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Slight
Clifterson: CgE, CHE, CRF—Rock land part of CRF too variable to be rated.	Poor: high content of coarse fragments.	Gravelly loam in CgE and CRF is good source of mixed gravel; channery loam in CHE is good source of gravel if crushed; no sand.	Good	Slight	Slight	Slight
Crowheart: Cw	Poor: soluble salts.	Good source of gravel below depth of 30 inches.	Fair to poor to a depth of 30 inches; A–4 and A–6 material; good below depth of 30 inches.	Moderate: somewhat poor drainage.	Moderate: somewhat poor drainage.	Severe: somewhat poor drainage.
*Effington: Ef, En, EP—For Apron part of EP, see Apron series.	Poor: alkali.	Unsuitable: excessive fines.	Poor: A–6 and A–7 material.	Moderate for Ef and EP because of mostly moderate shrink-swell potential; severe for En because of high water table.	Moderate for Ef and EP because of mostly moderate shrink-swell potential; severe for En because of high water table.	Slight for Ef and EP; severe for En because of high water table.
Eg	Poor: alkali.	Good source of gravel below depth of 20 to 40 inches.	Poor to a depth of 20 to 40 inches; A–6 and A–7 material; good below depth of 20 to 40 inches.	Moderate: mostly moderate shrink-swell potential.	Moderate: mostly moderate shrink-swell potential.	Moderate: gravel substratum.

See footnotes at end of table.

engineering properties of the soils—Continued

Degree and kind of limitations for—			Soil features affecting—			Hydrologic soil groups
Septic-tank absorption fields	Sewage lagoons	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	
Severe: very slow permeability.	Slight	Very slow permeability; bedrock at depth of 10 to 20 inches.	Medium to low shear strength and piping hazard; low permeability if compacted.	Very slow permeability.	Very slow permeability; alkaline.	D
Severe: very slow permeability.	Slight	Very slow permeability.	Medium to low shear strength and piping hazard; low permeability if compacted.	Very slow permeability.	Alkaline; very slow permeability.	D
Moderate to severe: 3 to 30 percent slopes.	Severe: moderately rapid permeability.	Moderately rapid permeability.	Medium to low piping hazard and permeability if compacted; medium to high shear strength.	Moderately rapid permeability.	Low available water capacity; moderately rapid permeability.	B
Severe: water table at depth of 3 to 5 feet.	Severe: water table at depth of 3 to 5 feet; moderately rapid to rapid permeability.	Moderately rapid permeability.	Where mixed, medium shear strength, piping hazard, and permeability if compacted.	Outlet difficult to locate.	Soluble salts; somewhat poor drainage.	B if drained; C if not drained.
Severe: slow permeability.	Slight for Ef and EP; severe for En because of high water table.	Slow permeability.	Medium shear strength; low permeability if compacted; medium to low piping hazard.	Slow permeability.	Strongly alkaline.	C for Ef and EP; D for En.
Slight: may contaminate water supply.	Severe: rapid permeability below depth of 20 to 40 inches.	Slow permeability in upper part.	Where mixed, medium to high shear strength; medium to low piping hazard; medium permeability if compacted.	Outlet difficult to locate.	Strongly alkaline.	C

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as source of—			Degree and kind of limitations for—		
	Topsoil	Sand and gravel	Road fill	Local roads and streets	Dwellings without basements	Shallow excavations
*Enos: ESB. For Wall part of ESB, see Wall series. For Occanet part of ESB, see Occanet series. Rock land part of ESB too variable to be rated.	Entire soil good if mixed.	Fair for sand: 15 to 25 percent fines; no gravel.	Good	Moderate: bedrock at depth of 20 to 40 inches.	Moderate: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.
Ethete: EtA, EtB, EuB	Surface horizons are fair; EuB is slightly saline.	Good source of gravel below depth of 20 to 40 inches.	Fair if mixed A–6 and A–7 material; subsurface horizons are good.	Moderate: moderate shrink-swell potential; severe for EuB because of water table at depth of 3 to 5 feet.	Moderate: moderate shrink-swell potential; severe for EuB because of water table at depth of 3 to 5 feet.	Moderate: gravel at depth of 20 to 40 inches; severe for EuB because of high water table.
Fivemile: FmA, FnA, FnB, FoB.	Surface horizon is good (FmA fair); silty clay loam texture; FoB is slightly saline and poor.	Unsuitable: excessive fines.	Poor: A–7 material.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Slight except that FoB has severe limitations because of somewhat poor drainage and water table at depth of 3 to 5 feet.
Fruita: FrA, FrB	Poor: strongly alkaline.	Unsuitable: excessive fines.	Poor: A–6 or A–7 material.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Slight
Glenton: Gn	Good	Poor source of sand; no gravel.	Fair to good: A–2 and A–4 material.	Slight	Slight	Slight
Griffy: GrA, GrB, GrC	Good	Poor source of sand; no gravel.	Fair: A–4 material.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Slight
Gullied land: Gu. Too variable to be rated.						
Lostwells: LoA, LoB, LoC, LsB, LtB.	Good for LoA, LoB, and LoC; LsB is poor, strongly alkaline; LtB is fair, slightly saline.	Unsuitable: excessive fines.	Fair to poor: A–4 or A–6 material.	Moderate: moderate shrink-swell potential; LtB has water table at depth of 3 to 5 feet.	Moderate: moderate shrink-swell potential; LtB has water table at depth of 3 to 5 feet.	Slight except that LtB has moderate limitation because of water table at depth of 3 to 5 feet.

See footnotes at end of table.

engineering properties of the soils—Continued

Degree and kind of limitations for—			Soil features affecting—			Hydrologic soil groups
Septic-tank absorption fields	Sewage lagoons	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderately rapid permeability.	High piping hazard; medium shear strength and permeability if compacted.	Moderately rapid permeability; bedrock at depth of 20 to 40 inches.	Moderate intake rate; bedrock at depth of 20 to 40 inches.	C
Slight: rapid permeability if sand and gravel; may contaminate water supply; severe for EuB because of high water table.	Severe: rapid permeability below depth of 20 to 40 inches; water table at depth of 3 to 5 feet in EuB.	Moderate permeability.	Medium shear strength and permeability if compacted; low piping hazard if mixed.	Moderate permeability; rapid permeability in substratum; EuB has water table at depth of 3 to 5 feet.	High available water capacity; gravel substratum; EuB has water table at depth of 3 to 5 feet.	B for EtA and EtB; C for EuB.
Severe: moderately slow permeability; water table at depth of 3 to 5 feet in FoB.	Slight except that FoB has severe limitation because water table is at depth of 3 to 5 feet.	Moderately slow permeability.	Low shear strength; low piping hazard; low permeability if compacted.	Moderately slow permeability; some alkali in subsurface horizons; water table at depth of 3 to 5 feet in FoB.	High available water capacity; FoB has water table at depth of 3 to 5 feet.	B for FnA, FmA, and FnB; C for FoB.
Severe: moderately slow permeability.	Slight	Moderately slow permeability.	Medium to low shear strength and piping hazard; low permeability if compacted.	Moderately slow permeability.	Strongly alkaline; easily reclaimed.	B
Slight	Severe: moderately rapid permeability.	Moderately rapid permeability.	Medium to high piping hazard; medium shear strength; medium permeability if compacted.	Moderately rapid permeability.	High available water capacity.	B
Slight except that GrC has moderate limitation because of slope.	Moderate: moderate permeability; severe for GrC because of slope.	Moderate permeability.	Medium piping hazard, shear strength, and permeability if compacted.	Moderately rapid permeability in substratum.	High available water capacity.	B
Severe: moderately slow permeability; LtB has water table at depth of 3 to 5 feet.	Slight except that LtB has severe limitation because of water table at depth of 3 to 5 feet.	Moderately slow and slow permeability.	Medium to low shear strength and piping hazard; slow permeability if compacted.	Moderately slow and slow permeability.	High available water capacity; LsB is strongly alkaline; LtB is slightly saline.	B for LoA, LoB, and LoC; C for LsB and LtB.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as source of—			Degree and kind of limitations for—		
	Topsoil	Sand and gravel	Road fill	Local roads and streets	Dwellings without basements	Shallow excavations
Marsh: Ma. Too variable to be rated.						
*Meeteetse: MdB, MEB—— Loamy sand: MdB and Meeteetse loamy sand part of MEB.	Poor: loamy sand.	Poor for sand; no gravel.	Good surface layer; poor below: A–6 and A–7 material.	Slight——	Slight——	Slight——
Sandy clay loam—— For Mudray part of MEB, see Mudray loamy sand. For Birdsley part of MEB, see Birdsley series. For Boysen part of MEB, see Boysen series.	Poor: alkali—	Unsuitable: excessive fines.	Poor: A–6 and A–7 material.	Severe: high shrink-swell potential in subsoil.	Severe: high shrink-swell potential in subsoil.	Slight——
*Mudray: MmB, MtB—— Loamy sand: MmB. For Meeteetse part of MmB, see Meeteetse loamy sand. Sandy clay loam: MtB. For Meeteetse part of MtB, see Meeteetse sandy clay loam.	Poor: loamy sand and alkali.	Poor for sand; no gravel.	Poor: A–6 material.	Severe: shale bedrock at depth of 10 to 20 inches.	Severe: shale bedrock at depth of 10 to 20 inches.	Severe: shale bedrock at depth of 10 to 20 inches.
*Oceanet: OcC, ORE—— Rock land part of ORE is too variable to be rated.	Fair: bedrock at depth of 10 to 20 inches.	Poor for sand; no gravel.	Good: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Pavillion: PaA, PaC, PcB—	Good for PaA and PaC; PcB is fair, because it is strongly alkaline.	Unsuitable: excessive fines.	Fair: A–4 material.	Moderate: bedrock at depth of 20 to 40 inches.	Moderate: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.
*Persayo: PeE, POD, PRE— For Oceanet part of POD and PRE, see Oceanet series. Rock land part of POD and PRE too variable to be rated. For Worland part of PRE, see Worland series.	Poor: bedrock at depth of 10 to 20 inches.	Unsuitable: excessive fines.	Poor: A–6 material.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Rock land: RS. Too variable to be rated.						
Saddle: SaA, SaC——	Good——	Unsuitable: excessive fines.	Good to fair: A–2 or A–4 material.	Moderate: bedrock at depth of 20 to 40 inches.	Moderate: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.
Saline wet land: Sw. Too variable to be rated.						

See footnotes at end of table.

engineering properties of the soils—Continued

Degree and kind of limitations for—			Soil features affecting—			Hydrologic soil groups
Septic-tank absorption fields	Sewage lagoons	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	
Severe: slow permeability.	Slight	Rapid permeability in surface horizon, slow permeability in subsoil.	Medium to low shear strength and piping hazard; slow permeability if compacted.	Slow subsoil permeability.	Very strongly alkaline subsoil.	C
Severe: slow permeability.	Slight	Slow permeability.	Medium to low shear strength and piping hazard; slow permeability if compacted.	Slow subsoil permeability.	Very strongly alkaline.	C
Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Medium to low shear strength and piping hazard; slow permeability if compacted.	Bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches; very strongly alkaline.	D
Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Medium shear strength and permeability if compacted; medium to high piping hazard.	Bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	D
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; moderate permeability.	Medium shear strength; medium to low piping hazard; slow permeability if compacted.	Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	C
Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Medium shear strength; medium to low piping hazard; slow permeability if compacted.	Bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	C
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Medium shear strength; medium to high piping hazard; slow permeability if compacted.	Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	C

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as source of—			Degree and kind of limitations for—		
	Topsoil	Sand and gravel	Road fill	Local roads and streets	Dwellings without basements	Shallow excavations
Teapo: TcA, TcB, TeB	Good for TcA and TcB; TeB is fair because it is slightly saline.	Unsuitable: excessive fines.	Fair to poor: A–4 or A–6 material.	Moderate: moderate shrink-swell potential; TeB has moderate limitation because of somewhat poor drainage.	Moderate: moderate shrink-swell potential; TeB has moderate limitation because of somewhat poor drainage.	Severe. bedrock at depth of 20 to 40 inches; TeB has severe limitation because of somewhat poor drainage.
Tipper [1]	Poor: loamy sand.	Poor for sand; no gravel.	Good	Moderate: bedrock at depth of 20 to 40 inches.	Moderate: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.
Tipperary: TmB, TmC, TnD, TOE, TRE. For Tipper part of TOE, see Tipper series. For Oceanet part of TOE and TRE, see Oceanet series. For Trook part of TRE, see Trook series. For Persayo part of TRE, see Persayo series.	Poor: loamy sand and sand.	Poor for sand; no gravel.	Good	Slight	Slight	Slight
*Trook: TsA, TsB, TsC, TtB, TUB, TVD. For Apron part of TUB and TVD, see Apron series. For Clifterson part of TVD, see Clifterson series. For Persayo part of TVD, see Persayo series.	Upper part of TsA, TsB, TsC, TUB, and TVD is good; TtB is fair because it is slightly saline.	Poor for sand: 15 to 35 percent fines; poor for gravel: 25 to 50 percent gravel.	Good	Slight except that TtB has moderate limitation because of somewhat poor drainage.	Slight except that TtB has moderate limitation because of somewhat poor drainage.	Slight except that TtB has severe limitation because of somewhat poor drainage.
Wall [2]	Fair if mixed	Poor for sand; no gravel.	Good	Slight	Slight	Slight
Wet alluvial land: Wa. Too variable to be rated.						
Winkleman: Wc, We, Wk	Poor: silty clay, slightly saline in We and Wk.	Unsuitable: excessive fines.	Poor: A–7 material.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: silty clay.

See footnotes at end of table.

engineering properties of the soils—Continued

Degree and kind of limitations for—			Soil features affecting—			Hydrologic soil groups
Septic-tank absorption fields	Sewage lagoons	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Medium shear strength and piping hazard; slow permeability if compacted.	Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; TeB is slightly saline and somewhat poorly drained.	C
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Medium shear strength; medium to high piping hazard; medium permeability if compacted.	Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	C
Slight except that TnD has severe limitation because of steep slopes.	Moderate for TmB; severe for TmC and TnD because of slope.	Rapid permeability.	Medium shear strength; medium to high piping hazard; medium permeability if compacted.	Rapid permeability.	Low available water capacity.	A
Slight except that TtB has severe limitation because of water table at depth of 3 to 5 feet.	Severe: moderately rapid permeability; TtB has water table at depth of 3 to 5 feet.	Moderately rapid permeability.	Medium shear strength; medium to high piping hazard; medium permeability if compacted.	Moderately rapid permeability.	High available water capacity.	B, except C for TtB.
Slight----------	Severe: moderately rapid permeability.	Moderately rapid permeability.	Medium shear strength; medium to high piping hazard; medium permeability if compacted.	Moderately rapid permeability.	Low available water capacity.	B
Severe: slow permeability.	Slight for Wa; severe for We and Wk because of high water table.	Slow permeability; We and Wk have high water table.	Low shear strength and piping hazard; slow permeability if compacted.	Slow permeability.	High available water capacity; low intake rate.	C, except D for Wk.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as source of—			Degree and kind of limitations for—		
	Topsoil	Sand and gravel	Road fill	Local roads and streets	Dwellings without basements	Shallow excavations
Worland: WoA, WoB, WoC, WrB, WSC. For Oceanet part of WSC, see Oceanet series. Rock land part of WSC too variable to be rated.	Good for WoA, WoB, WoC, and WSC; WrB is fair because it is slightly saline.	Poor for sand; no gravel.	Good to fair: A–2 or A–4 material.	Moderate: bedrock at depth of 20 to 40 inches.	Moderate: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.
Youngston: Yo	Fair: clay loam.	Unsuitable: excessive fines.	Poor: A–6 material.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: clay loam.

[1] Tipper soil mapped only as a part of the Tipperary-Tipper association.

TABLE 5.—*Engineering*

[Tests performed by the Wyoming State Highway Commission in accordance with standard

Soil name, sample number, and location of sample	Parent material	Laboratory No.	Depth from surface
			In
Apron sandy loam: S65 WYO–7–11, 264 feet W. and 129 feet S. of center of sec. 30, T. 2 N., R. 5 E. (Modal)	Alluvium.	68–187	6–10
Enos sandy loam: S65 WYO–7–14, on ridge 693 feet WNW. of E. quarter corner of sec. 28, T. 3 N., R. 1 E. (Thicker than modal B horizon)	Sandstone.	68–190 68–189	0–4 16–23
Ethete loam: S65 WYO–7–13, 723 feet W. and 54 feet N. of auto gate in SW¼SW¼ sec. 29, T. 3 N., R. 1 E. (Modal)	Alluvium.	68–194	6–14
Fivemile silty clay loam: S65 WYO–7–16, 760 feet NE. along road and 180 feet E. of center of bridge over Fivemile Creek in SE¼NE¼ sec. 25, T. 4 N., R. 1 E. (Modal)	Alluvium.	68–185	2–24
Griffy loam: S54 WYO–7–3, about 0.4 mile NE. of junction of U.S. Highway No. 26 and Paradise Valley Road, near E. quarter corner of sec. 12, T. 1 N., R. 3 E. (Modal)	Alluvium.	68–192	2–10
Lostwells sandy clay loam: S65 WYO–7–12, 804 feet W. and 306 feet S. of NE. corner of sec. 15, T. 1 N., R. 4 E. (Modal)	Alluvium.	68–188	0–11
Saddle sandy clay loam: S65 WYO–7–15, 906 feet W. and 87 feet S. of NE. corner of sec. 20, T. 3 N., R. 1 E. (Thicker than modal B horizon)	Shale.	68–184 68–183	0–6 6–18

[1] Analysis according to AASHO Designation: T88–57 (*1*). Results by this procedure frequently differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 milli-

engineering properties of the soils—Continued

Degree and kind of limitations for—			Soil features affecting—			Hydrologic soil groups
Septic-tank absorption fields	Sewage lagoons	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Medium shear strength; medium to high piping hazard; medium permeability if compacted.	Bedrock at depth of 20 to 40 inches.	High available water capacity; WrB is moderately saline and somewhat poorly drained.	C
Severe: moderately slow permeability.	Slight	Moderately slow permeability.	Medium to low shear strength and piping hazard; slow permeability if compacted.	Moderately slow permeability.	High available water capacity.	B

[2] Wall soil mapped only as a part of the Enos-Wall association.

test data

procedures of the American Association of State Highway Officials (AASHO)(*1*)]

Mechanical analysis [1]				Liquid limit	Plasticity index	Classification	
Percentage passing sieve—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)			AASHO	Unified
				Pct			
	100	96	42	25	3	A–4(1)	SM
	100	79	19		[2] NP	A–2–4(0)	SM
	100	79	20	21	[2] NP	A–2–4(0)	SM
	100	95	72	39	19	A–6(11)	CL
		100	84	42	25	A–7–6(14)	CL
	100	90	53	28	10	A–4(4)	CL
	100	96	49	30	10	A–4(3)	SC–CL
	100	88	35	20	[2] NP	A–2–4(0)	SM
	100	87	33	27	3	A–2–4(0)	SM

meters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes for soil.

[2] NP=Nonplastic

topdressing for lawns, gardens, roadbanks, and the like. The ratings indicate suitability for such use.

Sand and gravel ratings are based on the probability that delineated areas of the soil contain deposits of sand and gravel. The ratings do not indicate quality or size of the deposits.

Road fill is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for these purposes.

Local roads and streets are improved roads and streets that have an all-weather surfacing. Excluded are highways designated for fast-moving, heavy traffic. Except for the surface, local roads and streets are built mainly from the soil at hand. Properties to be considered are those that affect load-supporting capacity, stability of the subgrade, and the workability of the soil.

Dwellings without basements and other structures with similar foundation requirements are considered for buildings that do not have more than three stories. The stability of the foundation is emphasized, but wetness is also considered. For dwellings with basements, ratings for shallow excavations also should be considered.

Shallow excavations are those that require excavating or trenching to a depth of 5 or 6 feet. Desirable qualities and characteristics are good texture, a low water table, drainage, and absence of hard bedrock.

Septic tank absorption fields are soil absorption systems for sewage disposal. Factors considered are permeability, depth to bedrock, and depth to water table. Some soils underlain by rapidly permeable sand and gravel, such as the Ethete soils, may lead to contamination of ground water.

Sewage lagoons are shallow ponds used to hold sewage for the time required for bacterial decomposition. Deep, slowly permeable soils that do not have a water table are desirable for this use.

Pond reservoir areas are the basins or holding areas of a pond. Slowly permeable soils that restrict seepage are desirable for these reservoirs.

Embankments and dikes are earth structures built to confine water. Compaction characteristics, permeability, and susceptibility to piping are the principal properties considered in choosing sites for these structures.

Drainage of cropland and pasture depends on those features of the soil that influence its ability to transmit water.

Irrigation is affected by properties of the soil that limit it for shaping and leveling, for water intake, or in its capacity to hold water.

Soil hydrologic groups are groupings of soils based on potential runoff characteristics. Four groups—A, B, C, and D—are recognized. A has the lowest runoff, and D has the highest.

Engineering test data

To evaluate the soils for engineering purposes, samples from seven of the principal soil series of the Riverton Irrigated Area were tested by the Wyoming Highway Department. The results of these tests are given in table 5.

The engineering classifications in table 5 are based on data obtained by grain-size analysis and by tests to determine liquid and plastic limit. The grain-size analysis was made by the sieve method.

Liquid limit and plastic limit tests measure the effect of water on the consistency of soil material. As the moisture content of a clayey soil increases, the material changes from semisolid to plastic, and as the moisture content further increases, the material changes from plastic to liquid. The plastic limit is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is in a plastic condition. Some silty and sandy soils are nonplastic; that is, they do not become plastic at any moisture content.

Management of the Soils for Urban and Recreational Uses

This section provides information about factors to be considered when soils are used for urban and recreational purposes. Table 6 shows limitations of soils for homesites, lawns and landscaping, camp areas, picnic areas, playgrounds, and paths and trails. Discussed in this section, but not in table 6, are the use of soils for cemeteries and parking lots, the hazard of erosion, and trafficability. Because the soil limitations given in this survey are general, onsite soil investigations are necessary for determining exact soil conditions. Described in the following paragraphs is an explanation of the soil properties considered when the limitations of the soils were rated for urban uses.

Homesites.—In table 6 a general limitation of the soils for homesites is given. Many of the factors used to determine the suitability of an area for a homesite are discussed in the section "Engineering Uses of the Soils." Some of the factors considered in making the ratings were corrosivity ratings and suitability for septic-tank absorption fields, dwellings without basements, and shallow excavations. Soil properties considered were drainage, seasonal water table, flooding, slope, shrink-swell potential, Unified soil group, potential frost hazard, and depth to bedrock. Soil limitations for "Lawns and Landscaping" that are covered in this section were also considered.

Lawns and landscaping.—In table 6 the limitations of each soil for lawns and landscaping are given. Soil slope, surface texture, gravel and cobbles, depth to bedrock, natural drainage, permeability, available water capacity, salinity, and alkalinity were considered in determining the limitations. The limitations reflect the ability of the soil to support the growth of adapted species of lawn grasses and landscaping plants. The reader will need to refer to the engineering section for corrosivity of steel pipe if an underground sprinkler system is planned. The discussion on trafficability in this section may be helpful in planning lawn areas.

RECREATION

Most types of outdoor recreation require the use of land, and land primarily used for other purposes has recreation value. For example, cropland, range, and windbreaks are used for hunting. In the survey area the

most pressing need for recreational land is for camp areas, picnic areas, and playgrounds. In table 6 the soils of the survey area are rated for the limitations they imposed on these uses of the land and on its use for paths and trails.

Some recreational uses of land, such as golf courses, require special study, but information that will help with the planning of such facilities can be found in this section and in other places in this soil survey.

Camp areas.—Table 6 gives the limitations on use of the soils for camp areas (fig. 24). Soil slope, surface texture, natural drainage, hazard of flooding, permeability, and content of gravel and cobblestones were considered in determining the limitations of each soil. Camp areas intended for campers or camper trailers, for example, should have a slope of 4 percent or less. Other factors to be considered in site selection are the ability of the soil to support vegetation, the hazard of erosion, and the trafficability. These are discussed elsewhere in this section.

Picnic areas.—Table 6 shows the limitations on the use of each soil for picnic areas. Soil factors that were considered in the evaluation are: drainage, hazard of flooding, slope, surface texture, and the number of coarse fragments on the surface. The soil's suitability for growing vegetation, the hazard of erosion, and trafficability are also considered.

Playgrounds.—The limitations on the use of each soil for playgrounds are given in table 6. Playgrounds are areas developed for organized games such as badminton, volleyball, football, and baseball, or for rodeo arenas, racetracks, and roping arenas. Soil factors considered in determining the limitations are drainage, flooding, permeability, slope, surface texture, depth to bedrock, and the number of coarse fragments on the surface. Also to be considered are soil limitations for lawns and land-

***Figure 24.*—Camp area developed on Glenton sandy loam in Boysen State Park.**

TABLE 6.—*Degree and kinds of limitations of soils*

[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 soils for referring to other series that

Mapping unit	Soil limitations for—	
	Urban uses	
	Homesites	Lawns and landscaping
Apron sandy loam, 0 to 3 percent slopes	Slight	Slight
Apron sandy loam, 3 to 6 percent slopes	Slight	Moderate: 3 to 6 percent slopes.
Apron sandy loam, 6 to 10 percent slopes	Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.
Apron sandy loam, alkali, 0 to 6 percent slopes	Severe: severe limitation for lawns and landscaping.	Severe: very strongly alkaline.
Apron sandy loam, alkali substratum, 0 to 6 percent slopes	Severe: severe limitation for lawns and landscaping.	Severe: very strongly alkaline at a depth of 20 to 30 inches.
Apron sandy loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Apron sandy loam, wet, 0 to 6 percent slopes	Severe: poorly drained	Severe: poorly drained
Bigwin sandy loam	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Binton silty clay loam	Severe: high potential for frost action.	Severe: very strongly alkaline.
Binton silty clay loam, saline	Severe: high potential for frost action.	Severe: strongly saline.
Birdsley clay loam, 0 to 10 percent slopes	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
*Birdsley-Boysen complex, 0 to 10 percent slopes: For Birdsley part, see Birdsley clay loam, 0 to 10 percent slopes. For Boysen part, see Boysen sandy clay loam, 0 to 6 percent slopes. For Meeteetse part, see Meeteetse sandy clay loam part of Meeteetse soils, 0 to 6 percent slopes. For Pavillion part, see Pavillion sandy clay loam, alkali, 0 to 6 percent slopes.		
*Birdsley-Pavillion association, sloping: For Birdsley part, see Birdsley clay loam, 0 to 10 percent slopes. For Pavillion part, see Pavillion sandy clay loam, 3 to 10 percent slopes. For Apron part, see Apron sandy loam, 6 to 10 percent slopes.		
Boysen sandy clay loam, 0 to 6 percent slopes	Severe: severe limitation for growing vegetation.	Severe: very strongly alkaline.
Clifterson gravelly loam, 10 to 30 percent slopes	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.
Clifterson association, hilly	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.
*Clifterson-Rock land association, steep: For Clifterson part, see Clifterson gravelly loam, 10 to 30 percent slopes. For Rock land part, see Rock land. For Oceanet part, see Oceanet-Rock land association, hilly. For Persayo part, see Persayo part of Persayo-Oceanet association, steep.		

for urban and recreational uses

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Soil limitations for—Continued			
Recreational uses			
Camp areas	Picnic areas	Playgrounds	Paths and trails
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: 3 to 6 percent slopes.	Slight.
Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.	Severe: 6 to 10 percent slopes.	Slight.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Slight.
Slight	Slight	Severe: severe limitation for growing vegetation.	Slight.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: slow permeability	Moderate: silty clay loam surface layer.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: slow permeability	Moderate: silty clay loam surface layer.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: clay loam surface layer.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: slow permeability	Moderate: sandy clay loam surface layer.
Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Moderate: 10 to 30 percent slopes.
Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Moderate: 10 to 30 percent slopes.

TABLE 6.—*Degree and kinds of limitations of soils*

Mapping unit	Soil limitations for—	
	Urban uses	
	Homesites	Lawns and landscaping
Crowheart loam	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Effington sandy clay loam	Moderate to severe: moderate to high shrink-swell potential.	Severe: slow permeability.
Effington sandy clay loam, gravel substratum	Moderate to severe: moderate to high shrink-swell potential.	Severe: slow permeability.
Effington sandy clay loam, wet	Severe: poorly drained	Severe: poorly drained
*Effington-Apron association: For Effington part, see Effington sandy clay loam. For Apron part, see Apron sandy loam, 0 to 3 percent slopes.		
*Enos-Wall association, gently sloping:		
Enos part	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Wall part. For Oceanet part, see Oceanet sandy loam, 0 to 10 percent slopes. For Rock land part, see Rock land.	Slight	Moderate: 3 to 6 percent slopes.
Ethete loam, 0 to 3 percent slopes	Slight	Slight
Ethete loam, 3 to 6 percent slopes	Slight	Moderate: 3 to 6 percent slopes.
Ethete loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Fivemile sandy clay loam, 0 to 3 percent slopes	Severe: high potential for frost action.	Moderate: moderately slow permeability.
Fivemile silty clay loam, 0 to 3 percent slopes	Severe: high potential for frost action.	Moderate: moderately slow permeability.
Fivemile silty clay loam, 3 to 6 percent slopes	Severe: high potential for frost action.	Moderate: 3 to 6 percent slopes.
Fivemile silty clay loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Fruita clay loam, 0 to 3 percent slopes	Moderate: moderate shrink-swell potential.	Moderate: moderately slow permeability.
Fruita clay loam, 3 to 6 percent slopes	Moderate: moderate shrink-swell potential.	Moderate: 3 to 6 percent slopes.
Glenton sandy loam	Slight	Slight
Griffy loam, 0 to 3 percent slopes	Slight	Slight
Griffy loam, 3 to 6 percent slopes	Slight	Moderate: 3 to 6 percent slopes.
Griffy loam, 6 to 10 percent slopes	Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.
Gullied land: Too variable to be rated.		
Lostwells sandy clay loam, 0 to 3 percent slopes	Moderate: moderate shrink-swell potential.	Moderate: sandy clay loam surface layer.

for urban and recreational uses—Continued

Soil limitations for—Continued			
Recreational uses			
Camp areas	Picnic areas	Playgrounds	Paths and trails
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: slow permeability	Moderate: sandy clay loam surface layer.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: slow permeability	Moderate: sandy clay loam surface layer.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Slight	Slight	Moderate: 3 to 6 percent slopes	Slight.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Moderate: 3 to 6 percent slopes	Moderate: loamy sand surface layer.
Slight	Slight	Moderate: some gravel	Slight.
Slight	Slight	Moderate: 3 to 6 percent slopes	Slight.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Moderate: moderately slow permeability.	Moderate: sandy clay loam surface layer.	Moderate: moderately slow permeability.	Moderate: sandy clay loam surface layer.
Moderate: moderately slow permeability.	Moderate: silty clay loam surface layer.	Moderate: moderately slow permeability.	Moderate: silty clay loam surface layer.
Moderate: moderately slow permeability.	Moderate: silty clay loam surface layer.	Moderate: 3 to 6 percent slopes	Moderate: silty clay loam surface layer.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Moderate: moderately slow permeability.	Moderate: clay loam surface layer.	Moderate: moderately slow permeability.	Moderate: clay loam surface layer.
Moderate: moderately slow permeability.	Moderate: clay loam surface layer.	Moderate: 3 to 6 percent slopes	Moderate: clay loam surface layer.
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: some gravel	Slight.
Slight	Slight	Moderate: 3 to 6 percent slopes.	Slight.
Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.	Severe: 6 to 10 percent slopes	Slight.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.

TABLE 6.—*Degree and kinds of limitations of soils*

Mapping unit	Soil limitations for—	
	Urban uses	
	Homesites	Lawns and landscaping
Lostwells sandy clay loam, 3 to 6 percent slopes	Moderate: moderate shrink-swell potential.	Moderate: 3 to 6 percent slopes.
Lostwells sandy clay loam, 6 to 10 percent slopes	Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.
Lostwells sandy clay loam, alkali, 0 to 6 percent slopes	Moderate: moderate shrink-swell potential.	Moderate: sandy clay loam surface layer.
Lostwells sandy clay loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Marsh	Severe: very poorly drained.	Severe: very poorly drained.
Meeteetse loamy sand, 0 to 6 percent slopes	Severe: high shrink-swell potential.	Severe: slow permeability.
*Meeteetse soils, 0 to 6 percent slopes: For Meeteetse loamy sand part, see Meeteetse loamy sand, 0 to 6 percent slopes. Meeteetse sandy clay loam For Mudray part, see Mudray loamy sand part of Mudray-Meeteetse loamy sands, 0 to 6 percent slopes. For Birdsley part, see Birdsley clay loam, 0 to 10 percent slopes. For Boysen part, see Boysen sandy clay loam, 0 to 6 percent slopes.	Severe: high shrink-swell potential.	Severe: slow permeability; very strongly alkaline.
*Mudray-Meeteetse loamy sands, 0 to 6 percent slopes: Mudray loamy sand For Meeteetse part, see Meeteetse loamy sand, 0 to 6 percent slopes.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
*Mudray-Meeteetse sandy clay loams, 0 to 6 percent slopes: Mudray sandy clay loam For Meeteetse part, see Meeteetse sandy clay loam part of Meeteetse soils, 0 to 6 percent slopes.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches; very strongly alkaline.
Oceanet sandy loam, 0 to 10 percent slopes	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
*Oceanet-Rock land association, hilly: Oceanet part For Rock land part, see Rock land.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
Pavillion sandy clay loam, 0 to 3 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Pavillion sandy clay loam, 3 to 10 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: 3 to 10 percent slopes.
Pavillion sandy clay loam, alkali, 0 to 6 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Persayo sandy clay loam, 0 to 30 percent slopes	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
*Persayo-Oceanet association, steep: Persayo part For Oceanet part, see Oceanet part of Oceanet-Rock land association, hilly. For Rock land part, see Rock land.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.

for urban and recreational uses—Continued

Soil limitations for—Continued			
Recreational uses			
Camp areas	Picnic areas	Playgrounds	Paths and trails
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: 3 to 6 percent slopes.	Moderate: sandy clay loam surface layer.
Moderate: sloping	Moderate: sloping	Severe: 6 to 10 percent slopes	Moderate: sandy clay loam surface layer.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: very poorly drained	Severe: very poorly drained	Severe: very poorly drained	Severe: very poorly drained.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Severe: slow permeability	Moderate: loamy sand surface layer.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: slow permeability	Moderate: sandy clay loam surface layer.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: loamy sand surface layer.
Severe: severe limitation for growing vegetation.	Severe: severe limitation for growing vegetation.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: sandy clay loam surface layer.
Slight	Slight	Severe: bedrock at a depth of 10 to 20 inches.	Slight.
Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: 10 to 30 percent slopes.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: bedrock at a depth of 20 to 40 inches.	Moderate: sandy clay loam surface layer.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate to severe: 3 to 10 percent slopes.	Moderate: sandy clay loam surface layer.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: bedrock at a depth of 20 to 40 inches.	Moderate: sandy clay loam surface layer.
Moderate to severe: sandy clay loam surface layer; 0 to 30 percent slopes.	Moderate to severe: sandy clay loam surface layer; 0 to 30 percent slopes.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: sandy clay loam surface layer.
Severe: 20 to 30 percent slopes.	Severe: 20 to 30 percent slopes	Severe: bedrock at a depth of 10 to 20 inches.	Moderate to severe: 20 to 30 percent slopes.

TABLE 6.—*Degree and kinds of limitations of soils*

Mapping unit	Soil limitations for—	
	Urban uses	
	Homesites	Lawns and landscaping
*Persayo-Worland association, hilly: Persayo part	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
Worland part. For Oceanet part, see Oceanet part of Oceanet-Rock land association, hilly. For Rock land part, see Rock land.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.
Rock land	Severe: exposed rock	Severe: exposed rock
Saddle sandy clay loam, 0 to 3 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Saddle sandy clay loam, 3 to 10 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Saline wet land: Too variable to be rated.		
Teapo sandy clay loam, 0 to 3 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Teapo sandy clay loam, 3 to 6 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Teapo sandy clay loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Tipperary loamy sand, 0 to 6 percent slopes	Slight	Severe: low available water capacity.
Tipperary loamy sand, 6 to 10 percent slopes	Slight	Severe: low available water capacity.
Tipperary loamy sand, alkali, hummocky	Severe: severe limitation for growing vegetation.	Severe: very strongly alkaline.
*Tipperary-Tipper association, hilly: Tipperary part	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.
Tipper part. For Oceanet part, see Oceanet part of Oceanet-Rock land association, hilly.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.
*Tipperary-Trook association, hilly: For Tipperary part, see Tipperary part of Tipperary-Tipper association, hilly. Trook part. For Oceanet part, see Oceanet part of Oceanet-Rock land association, hilly. For Persayo part, see Persayo part of Persayo-Worland association, hilly.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.
Trook sandy loam, 0 to 3 percent slopes	Slight	Slight

for urban and recreational uses—Continued

Soil limitations for—Continued			
Recreational uses			
Camp areas	Picnic areas	Playgrounds	Paths and trails
Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: sandy clay loam surface layer.
Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Moderate: 10 to 30 percent slopes.
Severe: exposed rock.	Severe: exposed rock.	Severe: exposed rock.	Severe: exposed rock.
Slight: moderate if surface layer is sandy clay loam.	Slight: moderate if surface layer is sandy clay loam.	Moderate: bedrock at a depth of 20 to 40 inches.	Slight.
Slight: moderate if surface layer is sandy clay loam.	Slight: moderate if surface layer is sandy clay loam.	Moderate to severe: 3 to 10 percent slopes.	Slight.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: bedrock at a depth of 20 to 40 inches.	Moderate: sandy clay loam surface layer.
Moderate: sandy clay loam surface layer.	Moderate: sandy clay loam surface layer.	Moderate: 3 to 6 percent slopes.	Moderate: sandy clay loam surface layer.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Moderate: loamy sand surface layer.	Moderate: loamy sand surface layer.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Severe: 6 to 10 percent slopes.	Moderate: loamy sand surface layer.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Severe: severe limitation for growing vegetation.	Moderate: loamy sand surface layer.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Severe: 10 to 30 percent slopes.	Moderate: 10 to 30 percent slopes.
Severe: loamy sand surface layer.	Severe: loamy sand surface layer.	Severe: 10 to 30 percent slopes.	Moderate: 10 to 30 percent slopes.
Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Severe: 10 to 30 percent slopes.	Moderate: 10 to 30 percent slopes.
Slight.	Slight.	Slight.	Slight.

TABLE 6.—*Degree and kinds of limitations of soils*

Mapping unit	Soil limitations for—	
	Urban uses	
	Homesites	Lawns and landscaping
Trook sandy loam, 3 to 6 percent slopes	Slight	Moderate: 3 to 6 percent slopes.
Trook sandy loam, 6 to 10 percent slopes	Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.
Trook sandy loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
*Trook-Apron association, gently sloping: For Trook part, see Trook sandy loam, 3 to 6 percent slopes. For Apron part, see Apron sandy loam, 3 to 6 percent slopes.		
*Trook-Clifterson association, moderately steep: Trook part	Moderate to severe: 10 to 20 percent slopes.	Severe: 10 to 20 percent slopes.
Clifterson part	Moderate to severe: 10 to 20 percent slopes.	Severe: 10 to 20 percent slopes.
Apron part	Moderate to severe: 10 to 20 percent slopes.	Severe: 10 to 20 percent slopes.
Persayo part	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.
Wet alluvial land: Too variable to be rated.		
Winkleman silty clay	Severe: high shrink-swell potential.	Severe: silty clay surface layer.
Winkleman silty clay, saline	Severe: somewhat poorly drained.	Severe: silty clay surface layer.
Winkleman silty clay, wet	Severe: poorly drained	Severe: poorly drained
Worland sandy loam, 0 to 3 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Worland sandy loam, 3 to 6 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Worland sandy loam, 6 to 10 percent slopes	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Worland sandy loam, saline, 0 to 6 percent slopes	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
*Worland-Oceanet complex, 0 to 10 percent slopes: Worland part For Oceanet part, see Oceanet sandy loam, 0 to 10 percent slopes. For Rock land part, see Rock land.	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Youngston clay loam	Moderate: moderate shrink-swell potential.	Moderate: clay loam surface layer.

for urban and recreational uses—Continued

Soil limitations for—Continued			
Recreational uses			
Camp areas	Picnic areas	Playgrounds	Paths and trails
Slight	Slight	Moderate: 3 to 6 percent slopes	Slight.
Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.	Severe: 6 to 10 percent slopes	Slight.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Slight.
Moderate to severe: 10 to 20 percent slopes.	Moderate to severe: 10 to 20 percent slopes.	Severe: 10 to 20 percent slopes	Slight to moderate: 10 to 20 percent slopes.
Moderate to severe: 10 to 20 percent slopes.	Moderate to severe: 10 to 20 percent slopes.	Severe: 10 to 20 percent slopes	Moderate: gravelly loam surface layer.
Moderate to severe: 10 to 20 percent slopes.	Moderate to severe: 10 to 20 percent slopes.	Severe: 10 to 20 percent slopes	Slight to moderate: 10 to 20 percent slopes.
Moderate to severe: 10 to 20 percent slopes.	Moderate to severe: 10 to 20 percent slopes.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: sandy clay loam surface layer.
Severe: silty clay surface layer.	Severe: silty clay surface layer.	Severe: silty clay surface layer.	Severe: silty clay surface layer.
Severe: silty clay surface layer.	Severe: silty clay surface layer.	Severe: silty clay surface layer.	Severe: silty clay surface layer.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Slight	Slight	Moderate: bedrock at a depth of 20 to 40 inches.	Slight.
Slight	Slight	Moderate: 3 to 6 percent slopes	Slight.
Moderate: 6 to 10 percent slopes.	Moderate: 6 to 10 percent slopes.	Severe: 6 to 10 percent slopes	Slight.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Slight to moderate: 0 to 10 percent slopes.	Slight to moderate: 0 to 10 percent slopes.	Moderate to severe: 0 to 10 percent slopes; bedrock at a depth of 20 to 40 inches.	Slight.
Moderate: clay loam surface layer.	Moderate: clay loam surface layer.	Moderate: clay loam surface layer.	Moderate: clay loam surface layer.

scaping, trafficability, and the hazard of erosion. Athletic fields, including buildings and parking lots, will usually require 10 acres or more. For soil factors affecting buildings refer to the engineering section. Suitability of soils for parking lots is covered in this section. The reader will need to refer to the engineering section for corrosivity of steel pipe if an underground sprinkler system is planned.

Paths and trails.—The limitations on the use of each soil for paths and trails are given in table 6. In this interpretation, paths and trails are considered to be bridle paths and foot trails. Surface soil texture, drainage, hazard of flooding, slope, and the number of coarse fragments on the surface were considered in determining limitations. Trafficability and the hazard of erosion also need to be considered in planning paths and trails.

Cemeteries.—In selecting sites for cemeteries, the soil limitations for homesites can generally be used. For cemeteries bedrock should be at a depth of more than eight feet for the limitation to be slight. Bedrock, except for soft shale, that is above a depth of eight feet is a severe limitation. A water table above a depth of eight feet severely limits soil for use as a cemetery. The reader will want to refer to the rating for shallow excavations in the engineering section. Soil limitations for lawns and landscaping should be considered. If an underground sprinkler system is planned, the reader will want to refer to the engineering section for corrosivity of steel pipe.

Parking lots.—In selecting sites for parking lots, the soil limitations for local roads and streets of the engineering section can generally be used by narrowing the allowable slopes. A slope of 0 to 3 percent involves a slight limitation; 3 to 6 percent, a moderate limitation; and more than 6 percent, a severe limitation. If parking lots are not surfaced, trafficability should be considered. The hazard of erosion also should be considered in planning parking lots.

Hazard of erosion.—The grading and shaping of land for urban developments leaves the soil surface unprotected. Paved streets and parking lots and the roofs of buildings increase the runoff water that must be carried away. These factors combined result in an increased hazard of erosion in urban areas. Erosion-control measures such as grassed or paved waterways, diversion terraces, or open or closed drains may be necessary to prevent erosion and siltation.

Trafficability.—Trafficability is the soil property that allows vehicular and foot traffic on the soil surface over a range of moisture conditions. Soil consistence is an important factor in rating trafficability. Soils with good trafficability are friable when moist and nonsticky when wet. They have moderate to moderately rapid permeability and are generally sandy loam, sandy clay loam, or loam. Ethete and Lostwells soils have good trafficability. Soils with fair trafficability are soft when dry or slightly sticky when wet. Texture of these soils is generally loamy sand, clay loam, or silty clay loam. Tipperary and Fivemile soils have fair trafficability. Soils with poor trafficability are sticky when wet. The sticky consistence is the result of high clay content or high exchangeable sodium. Winkleman and Boysen soils have poor trafficability.

Formation and Classification of the Soils

This section discusses the major factors of soil formation that affect the soils of the survey area and explains the formation of soil horizons. It also describes the current system of soil classification and places the soil series in the appropriate higher categories of the current system.

Factors of Soil Formation

Soil is a natural formation on the surface of the earth in which plants grow. It consists of mineral and organic matter. Soils differ in their appearance, composition, productivity, and management requirements within short distances. The properties of the soil at any given place result from the integrated effects of five major factors of soil formation: parent material, living matter, climate, relief or topography, and time (*3*). No single factor is responsible for all of the soil differences. All of the factors act together, but at differnt rates, to form ach individual soil. The relative importance of the factors varies, and in places one may be more important than the others.

Parent material

Many of the physical and chemical properties of the soils are strongly influenced by the parent material. A very young soil is influenced more by parent material than by climate or vegetation. The soils of the survey area formed principally in alluvium that was derived from the interbedded clay shale and sandstone of the Wind River Formation, which is of the Tertiary Age.

The Wind River Formation is the predominant bedrock formation in the survey area. It is a continental shale consisting of a series of interbedded lenticular sandstone, shale, siltstone, and claystone and small beds of conglomerate tuff and freshwater limestone. These beds are poorly consolidated in most places.

The Wind River Formation can be divided into two parts by color and lithology. The upper part is brightly colored and variegated. It consists of red, yellow, blue, purple, and white siltstone, clay shale, freshwater limestone, and a basal conglomerate. The lower part is drab colored. It consists of greenish-gray siltstone and clay shale and tan sandstone. The brightly colored part is principally in the northeastern part of the survey area. The drab-colored part occupies the other part of the survey area where this formation is the bedrock.

Birdsley and Mudray soils formed in residuum from the upper parts of the Wind River Formation. Meeteetse, Boysen, and Effington soils formed in deposits of alluvium that were derived from the upper parts of the Wind River Formation. Saddle, Pavillion, and Persayo soils formed in residuum from the shales of the lower part of the Wind River Formation. Oceanet, Worland, and Enos soils formed in residuum from the sandstone of the lower part. Griffy and Lostwells soils formed in the mixed alluvium from the lower part. Apron and Tipperary soils formed in deposits of alluvium that were derived from the sandstone. Fruita soils formed in mixed alluvium derived from both the upper and lower parts of the Wind River Formation.

In a small part of the Area, west of Pilot Butte, the bedrock is of the Cretaceous Age. The principal formation

is Mesaverde Sandstone, and there are minor exposures of shale. The shale is probably part of the Lewis and Cody Formations. Soils associated with these rocks are the ones associated with the lower part of the Wind River Formation; that is, the Saddle, Pavillion, and Persayo soils.

In the northeastern corner of the Area is a small area of crystalline Pre-Cambrian rocks and a small area of highly faulted, steeply dipping rocks of the Paleozoic and Mesozoic Ages. Little soil has formed in these areas; they are mapped mainly as Rock land.

Two major terrace systems are in the survey area. One of these is along the Wind River in the southern part of the Area, and the other is an outwash plain in the northern part of the Area. The terraces along Wind River formed in mixed material washed from the Absaroka and Wind River Ranges. These terraces contain material from volcanic and other crystalline rocks. The pebbles and cobblestones in these terraces are well rounded. The soils are of the Ethete, Griffy, and Clifterson series.

The outwash plains in the northern part of the survey area are Trook and Cottonwood Benches. These outwash plains have a high content of sand, and they contain much angular limestone in the coarse fraction. The source of the material forming the plains is in the Owl Creek Mountains north of the survey area. The main soils on these outwash plains are in the Trook and Tipperary series.

The alluvium along the Wind River was derived from the Wind River and Absaroka Ranges. The pebbles are similar to those found on the Wind River terraces. Soils that formed in this alluvium are in the Bigwin and Crowheart series. The alluvium along Fivemile Creek through the central part of the area was derived from rocks of the Triassic and Permian Ages in the Circle Ridge area. This area is northwest of the survey area. Fivemile soils formed in this sediment.

Living matter

Living matter is considered one of the active factors of soil formation. The other is climate. The active factors influence soil characteristics over wide areas. The term "living matter" represents all forms of life that live on or in the soil, from microscopic bacteria to trees and mammals, including man. The chief function of living matter is to provide the biological community that is essential in changing inert rock material into soil. The first stage of soil formation is the addition of organic matter.

Under shrub and grass vegetation, such as that in the survey area, the soils tend to have slight accumulations of organic matter in the surface horizons. Different types of vegetative cover give rise to different soil characteristics. Very wet soils have heavier accumulations of organic matter on the surface. There are some scattered patches of Wet alluvial land in the survey area that have a thin peat horizon.

Many of the soils of the survey area show a strong influence of man. By cultivating and leveling the soil, men have altered the natural soil horizons. This changes the character of these soils and sometimes the classification. Soils that are now classified as Lostwells, for example, were classified as Fruita or Griffy in places before leveling and cultivation.

Men have irrigated in excess in many areas, causing the soils to become wet or salty. A water table in the soil causes changes in soil. Because the soil is water saturated, air is excluded, chemical reduction of the soil takes place, and the soil develops mottles and gley. Examples of this condition are found in Wet alluvial land. The presence of a water table also causes an accumulation of soluble salts in the soil. The salt accumulation adversely affects plant growth and thus retards soil formation. Examples of this condition are the saline phases of Lostwells and Apron soils.

Climate

Climate has both a direct and an indirect effect on soil formation (7). The chief components of climate are precipitation, temperature, humidity, wind, and sunshine. Moisture added to the soil in the form of precipitation promotes leaching and physical, chemical, and biological activity. Leaching is the downward movement of soluble compounds by percolating water. The physical activity is the shrinking and swelling that occurs along with changes in moisture content. Moisture combining with temperature promotes frost action. Indirectly, moisture affects the soil by its effect on vegetation. Temperature affects break-exposed bedrock by expansion, contraction, and frost action. Temperature has an indirect effect on soil formation by determining the length of the growing season. The main effect of humidity is through plant growth. In arid climates like that of this survey area, wind is very active in soil formation. Wind blowing against exposed sandstone and, to a lesser extent, against shale, dislodges particles. These particles are, in turn, transported by the wind. Wall soil is an example of a soil formed from wind-laid material. The surface soil of many areas has been reworked by wind. Sunshine is active in promoting plant growth and in warming the soil surface. A detailed account of the climate is included in the section "General Nature of the Area."

In addition to the climatic components and their influence on vegetation, the physical characteristics of the parent material must be considered in determining the impact of climate on the formation of a particular soil. The water intake is determined by the texture of the parent material. As soil formation begins, structure also influences water intake.

Relief

The principal influence of relief on soil formation is through its effect on microclimate and runoff.

The survey area is in the central part of a structural basin. The margin of the basin is outside of the survey area except where the area extends to the Owl Creek Mountains at Wind River Canyon. The general slope of the bedrock is to the northeast toward Wind River Canyon. The alluvial fan soils, Apron and Lostwells, are on pediments.

Old, high, remnant terraces are present as isolated, flat-topped buttes in the survey area. Big Ridge, Lost Wells Butte, and Griffy Hill are examples of these. Griffy, Ethete, and Clifterson soils are on these butte tops. There are also scattered bedrock buttes associated with the Wind River Formation. Pilot Butte and Sand

Butte are examples of these. Soils on these buttes are of the Persayo and Oceanet series.

Nearly level flood plains lie along the major drainageways of the survey area. These were described in the section on parent material.

Relief influences the microclimate, which influences vegetation, which in turn influences the development of the soil. This is an example of the interrelationship of the factors of soil formation and of their varying effects on soil properties. Because of topographic position, soils like Wet alluvial land formed in swales and depressions.

Relief and runoff are interrelated. The steeper the slope, the more runoff and the greater the erosion. This erosion acts to shape the landscape. Different kinds of rock erode at different rates and in different configurations, giving rise to varied topography. Shales of the Wind River Formation erode to form rounded topography. The sandstone members erode to form ledgy topography. The Persayo soils are a good example of soils that formed in areas of rounded topography. The Persayo-Oceanet association has ledgy topography.

Time

The length of time required for a soil to form depends largely upon the other factors of soil formation. The "age" of a soil is its relative stage of formation. Soils are referred to as being young or old much in the way people are classified (i.e., mature, middle-aged). A mature or normal soil is in equilibrium with its environment. A young soil has little horizon development and is still tending toward equilibrium.

Some soils that formed in alluvium, such as Lostwells and Bigwin, are receiving fresh parent material almost every year. These soils may form thin horizons of humus accumulation. They are youthful soils.

Some soils on the more stable landscapes of the survey area are beginning to form horizons that indicate aging. In addition to the accumulation of humus in the A horizon, clay is accumulating in the B2 horizon. Depletion of bases in the A horizon and upper part of the B horizon results in the accumulation of bases in the lower part of the B or upper part of the C horizon. Pavillion and Saddle soils formed in similar parent material and are in this stage of formation. Close examination of Pavillion and Saddle soils shows that the movement of bases is more advanced in the Saddle soils than in the Pavillion soils. Also, Saddle soils have more clay accumulation in the B2 horizon. This would indicate that Saddle soils are older than Pavillion soils.

Geologic history indicates that the soils of the survey area began forming in the late Oligocene period or later.

Formation of Horizons

The first stage in the formation of soil horizons is the accumulation of humus to form the A horizon. Soils of the Apron, Lostwells, Tipperary, and Bigwin series are in this stage of horizon formation.

As horizon formation continues, carbonates and other bases are leached from the solum, and the formation and translocation of silicate clay is begun. In some soils of this Area, base accumulations in the lower part of the B and upper part of the C horizon are becoming detectable. In some of these same soils, silicate clays are accumulating in the B2 horizon, as evidenced by clay films on the surface of peds and an increase in total clay. Pavillion and Ethete soils are at this stage of formation.

As formation continues, the profile is leached of carbonates, and an argillic horizon (*9*) is formed. Soils representative of this stage of formation are those of the Griffy, Saddle, and Enos series.

In some soils of the Area, natric horizon, a sodium-charged argillic horizon, is formed. Soils with natric horizons were called Sononetz soils in the 1938 yearbook classification (*6*). Meeteetse soils are the best example of this group.

In very wet soils, air is excluded. This causes the reduction of iron. This process results in a gray or blue-gray color in the soil and is called gleying. The soils in Wet alluvial land have gleyed horizons.

Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*6*), and later revised (*5*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 (*10*). This system is under continual study, and readers interested in the development of the system should refer to the available literature.

The current system defines classes in terms of observable or measurable properties of soils. The properties chosen are primarily those that permit the grouping of soils that are similar in genesis. The classification is designed to encompass all soils. It has six categories. Beginning with the most inclusive, they are the order, the suborder, the great group, the subgroup, the family, and the series. In table 7 the soil series are placed in families, subgroups, and orders. All of the categories in the current system are defined in the following paragraphs.

ORDER.—Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Three of the ten soil orders are represented in the survey area. They are Entisols, Inceptisols, and Aridisols.

Entisols are soils that lack distinct horizons. The Entisols in this area are represented by Psamments, Orthents, and Fluvents suborders.

The Psamments are very sandy soils. The Fluvents are the thinly stratified Entisols that have an organic-matter content that decreases irregularly with depth. The Orthents are the other Entisols. Entisols were classified as Azonal soils in the 1938 classification.

Inceptisols of the survey area have a gleyed horizon or iron staining. All the soils in this order are in the Aquepts suborder. These soils were classified as Intrazonal soils in the 1938 classification.

The Aridisols are the soils of dry places that show the most distinct horizons. They have diagnostic subsurface horizons. Aridisols in this Area are in the Orthids, Argids, or Natragids suborder.

SUBORDER.—Each order is divided into suborders, primarily on the basis of characteristics that seem to produce classes having genetic similarity. Mainly, these are characteristics that reflect either the presence or absence of waterlogging or soil differences resulting from the climate and vegetation. The climatic range is narrower than that of orders.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major horizons and similarity of features of corresponding horizons. The horizons considered are those in which clay, iron, or humus has accumulated and those that have pans that interfere with the growth of roots or the movement of water. The features selected are the self-mulching properties of clays, soil temperature, chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of another great group, suborder, or order. Subgroups may also be made in instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils in engineering use. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is the group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

General Nature of the Area

This section is provided primarily for those who are not familiar with the survey area. It gives information about physiography, relief, drainage, climate, history and development, transportation, utilities, industry, water supply, farming, and native vegetation.

Physiography, Relief, and Drainage

The survey area is mainly in the Wind River Basin (*2*). The northeast corner of the area is where the Owl Creek Mountains and the Bridger Mountains come together. The Wind River Basin is the western part of the Shoshoni Basin, which is a subordinate of the Wyoming Basin. The Owl Creek and Bridger Mountains are part of the Middle Rocky Mountains.

The Wyoming Basin interrupts the continuity of the Rocky Mountains. It is divided into subordinate basins by the mountains of the Middle Rocky Mountain Province.

Between the Rattlesnake and Wind River Ranges on the south and the Owl Creek and Bridger Mountains on the north is the Shoshoni Basin, which is a long, synclinal trough. This basin is separated from the Great Plains on the east by the Oil Mountain Anticline. The Oil Mountain Anticline is a series of low, monoclinal ridges. The Wind River, Rattlesnake, Owl Creek, and Bridger Mountains rise steeply from the floor of the basin.

TABLE 7.—*Classification of soil series by higher categories*

Series	Family	Subgroup	Order
Apron	Coarse-loamy, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Bigwin	Coarse-loamy over sandy or sandy-skeletal, mixed, calcareous, mesic.	Fluventic Haplaquepts	Inceptisols.
Binton	Fine-loamy, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.
Birdsley	Loamy, mixed, calcareous, mesic, shallow	Typic Torriorthents	Entisols.
Boysen	Fine-loamy, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.
Clifterson	Loamy-skeletal, mixed, calcareous, mesic	Typic Torriaothents	Entisols.
Crowheart	Coarse-loamy over sandy or sandy-skeletal, mixed, calcareous, mesic.	Fluventic Hplraquepts	Inceptisols.
Effington	Fine, montmorillonitic, mesic	Typic Natrargids	Aridisols.
Enos	Coarse-loamy, mixed, mesic	Typic Haplargids	Aridisols.
Ethete	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Haplargids	Aridisols.
Fivemile	Fine-silty, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.
Fruita	Fine-loamy, mixed, mesic	Typic Haplargids	Aridisols.
Glenton	Coarse-loamy, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.
Griffy	Fine-loamy, mixed, mesic	Typic Haplargids	Aridisols.
Lostwells	Fine-loamy, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.
Meeteetse	Fine, montmorillonitic, mesic	Typic Natrargids	Aridisols.
Mudray	Fine, montmorillonitic, mesic, shallow	Typic Natrargids	Aridisols.
Oceanet	Loamy, mixed, calcareous, mesic, shallow	Typic Torriorthents	Entisols.
Pavillion	Fine-loamy, mixed, mesic	Typic Camborthids	Aridisols.
Persayo	Loamy, mixed, calcareous, mesic, shallow	Typic Torriorthents	Entisols.
Saddle	Fine-loamy, mixed, mesic	Typic Haplargids	Aridisols.
Teapo	Fine-loamy, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Tipper	Mixed, mesic	Typic Torripsamments	Entisols.
Tipperary	Mixed, mesic	Typic Torripsamments	Entisols.
Trook	Coarse-loamy, mixed, mesic	Typic Calciorthids	Aridisols.
Wall	Coarse-loamy, mixed, mesic	Typic Camborthids	Aridisols.
Winkleman	Fine, montmorillonitic, calcareous, mesic	Typic Torrifluvents	Entisols.
Worland	Coarse-loamy, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Youngston	Fine-loamy, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.

The Owl Creek and Bridger Mountains are an east-west range with a granite core. The mountain front has many faults, and the rock strata are steeply dipping. The deeply entrenched Wind River Canyon separates the Owl Creek and the Bridger Mountains.

The lowest point in the survey area, about 4,590 feet above sea level, is in Wind River Canyon where Wind River leaves Fremont County. The elevation of Wind River at Diversion Dam, on the western edge of the survey area, is 5,566 feet. The elevation of Ocean Lake is 5,234 feet. The elevation of Pilot Butte is 5,857 feet, and that of Lostwells Butte is 5,675 feet.

The relief of the survey area is typical of intermountain desertic basin. The relief is the result of geologic processes that began with the mountain building. After the mountains were thrust up, the Tertiary Wind River Formation was deposited in the basin. This was followed by a period of erosion. Next a valley-filling formation of stratified sand and gravel was deposited. The shaping of the present landscape began during the erosion cycle that followed. Most of the terrace material and much of the underlying shale and sandstone was carried away, and the gravel-capped buttes of the basin were formed.

As the uplands eroded, alluvial fans were built along the valleys. Some alluvium was deposited along the streams. Most of the irrigated land in the survey area is on the alluvial fans. Some farmland is on the uplands and terraces. A remnant of the oldest terrace, Griffy Bench, rises about 500 feet above the lower terrace at Riverton. Pilot Butte, in the western part of the survey area, rises about 250 feet above the surrounding landscape. Lostwells Butte rises a maximum of 400 feet above the surrounding area.

The relief is characterized by flat-topped remnant terraces, gravel-capped buttes, and eroding uplands that have alluvial fans and recent alluvial deposits along the major drainages.

All drainage of the area is via the Wind River. The major subdrainages are Fivemile and Muddy Creeks. Wind River has a stable base grade. Both Fivemile and Muddy Creeks are downcutting.

A system of artificial drains carries excess irrigation water to the natural drainages. Ocean Lake in the west-central part of the area is the result of seep water from irrigation. The level of this lake is controlled by a drainage ditch to Fivemile Creek.

Climate [7]

The survey area is in central Wyoming, in the north-central part of Fremont County. It is bordered on the south and east by the Wind River and on the north by the Owl Creek Mountains, an east-west range that has peaks as high as 8,000 feet above average sea level. West of the Owl Creek Mountains are the Absarokas with peaks 11,000 to 13,000 feet above average sea level. At the eastern end of the Owl Creek Mountains is the Wind River Canyon. East of this canyon are the Bridger Mountains, which rise to 7,000 to 8,000 feet above average sea level. They extend eastward and join the Big Horn Mountains. To the southwest is the Wind River Range with peaks 12,000 to 13,000 feet above average sea level. In the Wind River Range is Wyoming's highest mountain, Gannett Peak, at 13,785 feet above average sea level. The Green Mountains, an east-west range that tops around 7,500 feet above average sea level, are southeast of the survey area.

Annual precipitation is low in this area, because the mountains are effective barriers to moisture. Most of the precipitation is in the form of showers and thunderstorms from spring through fall. Precipitation in winter is generally in the form of snow. The climate of the survey area is semiarid, but it is almost arid.

Cold-air outbreaks from Canada are largely blocked out of the survey area by the Big Horn Mountains, but occasionally very deep cold-air masses that have a strong southerly push enter the survey area. Very cold temperatures may then prevail for several days.

In table 8 is a summary of temperature and precipitation at Pavillion and Riverton. Temperatures have a wide range between summer and winter and between daily maximums and minimums. This is mainly because the high elevation and dry air permit rapid incoming and outgoing radiation as well as the passage of both warm- and cold-air masses. The area is in the latitudes of the prevailing westerlies, and most winds are downslope. Downslope wind warms at a rate of 5.5° F. for every 1,000 feet of descent because of the compression of the air. Thus, this area is subject to wide and sometimes abrupt changes in temperature and weather. Temperatures during the period of record 1931–60 were at a high of 101° and a low of −39° at Pavillion and a high of 104° and a low of −45° at Riverton. Even greater extremes were observed during other years. The temperature at Pavillion was 102° on June 28 and July 17, 1919, and −42° on December 12, 1924. A minimum of −46° was reached at Riverton in January 1930 and January 1963.

Because of cold-air outbreaks from Canada, cold-air drainage off the mountains, and rapid cooling by radiation at night, freezes are not uncommon late in the spring and early in the fall. The average growing season is 138 days for temperatures above 32° and 154 days for temperatures above 28° at Pavillion and 121 days for temperatures above 32° and 142 days for temperatures above 28° at Riverton. Table 9 gives probabilities of the last freezing temperatures in spring and the first in fall at Pavillion and Riverton.

In the normal precipitation pattern of the survey area the lightest precipitation fall is during December, January, and February, and then the amount of precipitation that falls increases rapidly to a peak in May. Precipitation amounts decrease rapidly through June and July to a low in August. They increase a little to a secondary peak in September and October, and then decrease again to the winter minimum. Normally, about 45 percent (3.8 inches) of annual precipitation at Pavillion and 40 percent (3.4 inches) at Riverton falls between the average 32° freeze-free dates. For the 28° freeze-free period the figures are about 55 percent (4.8 inches) at Pavillion and about 50 percent (4.4 inches)

[7] By JOHN D. ALYEA, climatologist for Wyoming, National Weather Service, U.S. Department of Commerce.

TABLE 8.—*Temperature and precipitation*

[30-year period of record]

Month	Temperature					Average degree days (Base 65° F.)	Precipitation				
	Average daily maximum	Average daily minimum	Average monthly	Two years in 10 will have at least 4 days with—			Average	Number of days that have 0.10 inch or more	One year in 10 will have—		Average snow and sleet
				Maximum equal to or higher than—	Minimum equal to or lower than—				Less than—	More than—	
Pavillion, elevation 5,440 feet:	°F	°F	°F	°F	°F	No	In		In	In	In
January	31.5	7.9	19.7	50	−13	1,404	0.21	1	(1)	0.51	3.4
February	38.4	12.0	25.2	55	−9	1,114	.18	1	0.01	.41	3.3
March	47.8	19.9	33.9	64	1	964	.48	2	.06	1.02	6.9
April	59.5	30.3	44.9	75	18	603	1.18	3	.27	2.62	6.1
May	69.3	39.9	54.6	84	30	335	1.84	5	.41	3.38	1.3
June	78.6	47.5	63.1	91	38	135	1.27	3	.12	3.06	.3
July	87.0	53.2	70.1	96	46	19	.75	2	.15	1.51	0
August	85.1	51.7	68.4	94	43	25	.57	1	.06	1.13	0
September	75.4	43.2	59.3	88	32	207	.80	2	.03	1.73	.5
October	61.8	33.4	47.6	76	22	539	.81	2	.01	1.81	3.2
November	43.7	19.0	31.4	60	0	1,008	.40	1	.01	.89	5.4
December	35.3	11.6	23.5	52	−9	1,287	.18	1	.02	.37	3.3
Year	59.5	30.8	45.2			7,460	8.67	24			33.7
Riverton, elevation 4,954 feet:											
January	30.1	0.5	15.3	49	−21	1,541	0.21	1	(1)	0.49	3.4
February	37.1	6.7	21.9	56	−17	1,207	.25	1	(1)	.54	4.2
March	47.3	18.5	32.9	65	−1	995	.52	2	.20	.97	6.5
April	59.3	29.2	44.3	75	15	621	1.32	3	.35	2.92	6.1
May	69.7	38.5	54.1	85	28	347	1.81	5	.36	3.92	1.8
June	79.6	45.9	62.8	92	36	144	1.26	3	.21	2.45	.6
July	89.2	51.1	70.2	97	43	16	.67	2	.04	1.70	0
August	87.0	48.5	67.8	95	40	28	.44	1	.02	1.08	0
September	76.4	39.4	57.9	90	29	237	.76	2	.04	1.45	.6
October	62.9	29.5	46.2	79	18	583	.82	2	.11	2.02	2.9
November	43.5	14.6	29.1	62	−5	1,077	.53	2	.06	.95	6.5
December	34.0	5.4	19.7	51	−15	1,404	.20	1	(1)	.45	3.2
Year	59.7	27.3	43.5			8,200	8.79	25			35.8

[1] Trace.

at Riverton. The greatest precipitation measured in any one month was 5.8 inches in June 1967 at Pavillion and 6.22 inches in May 1921 at Riverton. The greatest amount of precipitation in one day, 2.04 inches, was reported at Pavillion in June 1948. No precipitation at all for an entire month is not uncommon in this area, especially in the winter months. The most snowfall reported in any one month was 22.0 inches at Pavillion and 29.0 inches at Riverton.

Sunshine is abundant in the survey area, and only a few days during the year do not have some sunshine. Although there is no instrumental record of sunshine duration in the survey area, it is estimated that the average is about 70 percent of possible sunshine annually and that the range is from about 65 percent late in fall and early in winter to a little more than 75 percent in summer.

Average relative humidity is comparatively low during the year and is estimated to be 50 to 55 percent. It ranges from about 60 to 65 percent early in winter to about 40 percent in midsummer. Daily ranges are estimated to average from 75 percent early in the morning to 50 to 55 percent in the heat of the day early in winter. During midsummer the range is estimated at 55 to 25 percent for the same times.

Winds are estimated to average about 12 miles per hour annually. They average about 14 to 15 miles per hour during winter and about 9 to 10 miles per hour during summer. Day winds typically are stronger than night winds, and occasional storms bring periods of fairly high winds that have gusts of more than 75 miles per hour.

History and Development

The first white man to visit this survey area was Sieur de la Verenfrye, a French-Canadian explorer. He arrived in 1743 or 1744. John Colter travelled up the Wind River in 1807 on his way to Jackson Hole and

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Pavillion—					
Spring:					
1 year in 10 later than	April 19	May 5	May 11	May 20	May 30
2 years in 10 later than	April 14	April 27	May 6	May 15	May 25
5 years in 10 later than	April 4	April 17	April 26	May 5	May 15
Fall:					
1 year in 10 earlier than	October 18	October 13	October 2	September 21	September 9
2 years in 10 earlier than	October 23	October 18	October 7	September 26	September 14
5 years in 10 earlier than	November 2	October 28	October 17	October 6	September 24
Riverton—					
Spring:					
1 year in 10 later than	April 28	May 13	May 22	June 4	June 17
2 years in 10 later than	April 25	May 10	May 19	June 1	June 14
5 years in 10 later than	April 2	April 17	April 26	May 9	May 22
Fall:					
1 year in 10 earlier than	October 15	October 5	September 23	September 14	September 6
2 years in 10 earlier than	October 20	October 10	September 28	September 19	September 11
5 years in 10 earlier than	October 29	October 19	October 7	September 28	September 20

Yellowstone. In the 1830's the fur trappers sometimes held their conclaves about 2 miles southeast of the location of Riverton at the junction of the Wind and Little Wind Rivers.

In 1868, when the Shoshone Indians ceded much of Wyoming to the United States, they retained a triangle of land bounded by the Owl Creek and Wind River Mountains and the Popo Agie and Wind Rivers. In 1904 the United States secured a treaty with the Indians for the use of the area north and west of the Wind River as an irrigation project. This is the area of this soil survey.

On August 15, 1906, Riverton became a town. It was planned and plotted before any buildings were built. Riverton is the largest town in Fremont County, and in 1960 it had 6,845 residents. Other towns within the survey area are Pavillion and Kinnear.

The first irrigation water was diverted from the Big Wind River into the Riverton Canal on April 5, 1907. Since that time, irrigation has continued to expand as storage dams and canals were built. In 1961 there were 463 farms in the survey area and 87,456 acres of irrigated land. The Bureau of Reclamation plans to irrigate more land on Muddy Ridge in the east-central part of the survey area.

Educational facilities are good, and modern school systems serve all parts of the survey area. Central Wyoming College, a newly organized junior college and vocational school, is located at the western edge of Riverton.

Riverton has several churches. Two churches are at Kinnear and one at Pavillion. The farm groups are well organized, and their community buildings are scattered throughout the area. Fire protection is provided by volunteer fire departments in the towns and by rural fire-protection groups.

Transportation and Utilities

The survey area is served by the Chicago and Northwestern Railroad. Freight trains arrive at Riverton three times a week. Direct connections to major farm markets in the midwest are provided. The Burlington Northern Railroad crosses the northeastern part of the survey area but has no stations within the survey area. Bonneville, a small town just east of the survey area, however, is a junction point for the two railroads.

Farm-to-market transportation facilities are good. U.S. Highway No. 26 crosses the survey area from east to west. U.S. Highway No. 20 crosses the northeastern part of the survey area and is part of the eastern boundary of the survey area. A state secondary road serves Pavillion, the only town not on a main highway. State secondary roads and well-maintained county roads serve the irrigated parts of the survey area.

Frontier Airlines provides feeder airline service. It has flights to Denver, Billings, and Salt Lake City. Charter air service is also available.

A local bus line provides service to Shoshoni and Rawlins to connect with transcontinental bus and rail services.

Electricity is provided in Riverton by the Pacific Power and Light Company and in the surrounding area by the Riverton Valley Electric Association. Natural gas is available in Riverton. In some of the rural areas, natural gas is available from pipelines that cross the survey area.

Telephone service is available in most of the survey area.

Industry

A variety of industries operate in the survey area. Many residents find employment in the oil and gas fields southeast of Riverton, the Gas Hills Uranium Mining District east of Riverton, and the sulphuric acid plant south of Riverton. Natural gas is produced at the Pavillion gas field. Oil is produced at the Pilot Butte oil field. Timber from the Dubois area is sawed and planed at mills in Riverton and Kinnear. Component parts for electronic data processing are manufactured in Riverton. Meat-packing plants are in Riverton and Kinnear, and creameries are in Riverton.

Water Supply

Irrigation water in the survey area is supplied by the Wind River. Water is diverted at Diversion Dam to supply the needs of the Riverton Reclamation Project. Water for this project is stored upstream in Bull Lake and also at Pilot Butte Reservoir. At Pilot Butte Reservoir, part of the water from the Wyoming Canal is diverted into the Pilot Canal.

The LeClair Canal, also called Riverton Number 2 Canal, and the Wyoming Central Canal supply water to Riverton Valley. The Hurtado and Argon Ditches supply water to Kinnear Valley. These canals and ditches depend upon direct flow from the river.

The water supply to the reclamation project is adequate. The canal systems that depend upon direct flow are short of water some years, and water must be purchased from holders of water rights downstream.

Farming

The survey area includes 375,432 acres, about 90 percent of which is used for farming and ranching. About 24 percent of the acreage is used for irrigated crops, and about 66 percent is in range.

Irrigated farming began in the survey area in 1907, with water supplied by the Riverton Canal. Most of the irrigated land is now irrigated by water from the Wyoming Canal. Construction of this canal began in 1920, and the first water was delivered in 1924.

The principal irrigated crops in the survey area are sugar beets, dry beans, alfalfa, oats, and barley. Production of corn for silage is on the increase. With the increase in corn production, there is also an increase in cattle feeding. Both cattle and sheep use the range.

No farm statistics are available for the survey area per se. All census data are reported for the whole of Fremont County.

Native Vegetation

The survey area is characteristic of the cold desertic basins of the Northern Rocky Mountains. The native vegetation consists mainly of grasses, forbs, and shrubs. The following is a list of the common native plants:

Common name	*Scientific name*
Alkali bluegrass	*Poa juncifolia*
Alkali cordgrass	*Spartina gracilis*
Alkali sacaton	*Sporobolus airoides*
Arkansas rose	*Rosa arkansana*
Baltic rush	*Juncus balticus*
Basin wildrye	*Elymus cinereus*
Beaked sedge	*Carex rostrata*
Beardless wildrye	*Elymus triticoides*
Big sagebrush	*Artemisia tridentata*
Birdfoot sagebrush	*Artemisia pedatifida*
Bluebunch wheatgrass	*Agropyron spicatum*
Blue grama	*Bouteloua gracilis*
Bottlebrush squirreltail	*Sitanion hystrix*
Bud sagebrush	*Artemisia spinescens*
Common reed	*Phragmites communis*
Canada wildrye	*Elymus canadensis*
Dogwood	*Cornus occidentalis*
Fringed sagewort	*Artemisia frigida*
Gardner saltbush	*Atriplex gardneri*
Golden sedge	*Carex aurea*
Greasewood	*Sarcobatus vermiculatus*
Green molley	*Kochia americana*
Green muhly	*Muhlenbergia racemosa*
Hoods phlox	*Phlox hoodi*
Horsetail	*Equisetum sp.*
Indian ricegrass	*Orzyopsis hymenoides*
Inland saltgrass	*Distichlis stricta*
Inland sedge	*Carex interior*
Juniper	*Juniperus monosperma*
Little bluestem	*Andropogon scoparius*
Lomatium	*Lomatium sp.*
Low rabbitbrush	*Chrysothamnus humilis*
Narrowleaf cottonwood	*Populus angustifolia*
Nebraska sedge	*Carex nebraskensis*
Needle-and-thread	*Stipa comata*
Needleleaf sedge	*Carex eleocharis*
Nuttall alkaligrass	*Puccinellia nuttalliana*
Plains pricklypear	*Opuntia polyacantha*
Prairie junegrass	*Koeleria cristata*
Prairie sandreed	*Calamovilfa longifolia*
Red three-awn	*Aristida longiseta*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Sandberg bluegrass	*Poa secunda*
Sand dropseed	*Sporobolus cryptandrus*
Scarlet globemallow	*Sphaeralcea coccinea*
Shadscale	*Atriplex confertifolia*
Silver buffaloberry	*Shepherdia argentea*
Simple wildrye	*Elymus simplex*
Skunkbush sumac	*Rhus trilobata*
Slender wheatgrass	*Agropyron pauciflorum*
Spiny hopsage	*Grayia spinosa*
Tall mannagrass	*Glyceria elata*
Textile onion	*Allium textile*
Thickspike wheatgrass	*Agropyron dasystachyum*
Threadleaf sedge	*Carex filifolia*
Water sedge	*Carex aquatilis*
Western virginsbower	*Clematis ligusticifolia*
Western wheatgrass	*Agropyron smithii*
Wild licorice	*Glycyrrhiza lepidota*
Willow	*Salix sp.*
Winterfat	*Eurotia lanata*
Woody aster	*Xylorrhiza parryi*

Literature Cited

(1) American Association of State Highway Officials.
1961. standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 v., illus.

(2) Fenneman, Nevin M.
1931. physiography of western united states. McGraw-Hill, 534 pp., illus.

(3) Jenny, Hans.
1941. factors of soil formation, a system of quantitative pedology. McGraw-Hill, 281 pp., illus.

(4) Portland Cement Association.
1962. pca soil primer. 52 pp., illus.

(5) Thorpe, James, and Smith, Guy D.
1949. higher categories of soil classification: order, suborder, and great soil groups. Soil Sci. 67: 117–126.

(6) UNITED STATES DEPARTMENT OF AGRICULTURE.
1938. SOILS AND MAN. U.S. Dept. Agr. Yearbook, 1,232 pp., illus.
(7) ———
1941. CLIMATE AND MAN. U.S. Dept. Agr. Yearbook. 1,248 pp., illus.
(8) ———
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook No. 18, 503 pp., illus.
(9) ———
1954. DIAGNOSIS AND IMPROVEMENT OF SALINE AND ALKALI SOILS. U.S. Dept. Agr. Handbook No. 60, 160 pp., illus.
(10) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 265 pp., illus. [Supplements issued in March 1967 and September 1968]
(11) UNITED STATES DEPARTMENT OF DEFENSE.
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS, AND FOUNDATIONS. MIL-STD-619B, 30 pp., illus.

Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

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.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Coppice mounds. Small mounds of soil at the base of plants. They are formed by wind deposition of soil.

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 have 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.

Effective depth (also called soil depth). The depth of the soil above bedrock. In this survey classes of depth are as follows: *very shallow*, less than 10 inches; *shallow*, 10 to 20 inches; *moderately deep*, 20 to 40 inches; and *deep*, 40 inches or more.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

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.

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.

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.

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:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

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.

Slope classes. In this survey the slope classes used are:

Simple slopes	*Complex slopes*	*Slope, in percent*
Nearly level	Nearly level	0 to 3
Gently sloping	Undulating	3 to 6
Sloping	Rolling	6 to 10
Moderately steep	Hilly	10 to 30
Steep	Steep	More than 30

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 grain* (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. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

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."

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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. In referring to a capability unit, a range site, or a windbreak suitability group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, page 10.
Estimated yields, table 2, page 41.

Engineering uses of the soils, tables 3, 4, and 5, pages 50 through 65.

Map symbol	Mapping unit	Page	Capability subclass (Dryland) Symbol	Page	Capability unit (Irrigated) Symbol	Page	Range site Name	Page	Windbreak suitability group Number
ApA	Apron sandy loam, 0 to 3 percent slopes	11	VIe	38	IIe-5	33	Sandy	44	II
ApB	Apron sandy loam, 3 to 6 percent slopes	11	VIe	38	IIIe-5	36	Sandy	44	II
ApC	Apron sandy loam, 6 to 10 percent slopes	11	VIe	38	IVe-5	37	Sandy	44	II
ArB	Apron sandy loam, alkali, 0 to 6 percent slopes	11	VIIs	40	----	--	Saline Lowland	43	III
AsB	Apron sandy loam, alkali substratum, 0 to 6 percent slopes	12	VIe	38	----	--	Sandy	44	III
AtB	Apron sandy loam, saline, 0 to 6 percent slopes	12	VIws	39	IIIws-10	37	Saline Sub-irrigated	42	III
AuB	Apron sandy loam, wet, 0 to 6 percent slopes	12	VIw	39	----	--	Wetland	41	Unsuited
Bg	Bigwin sandy loam	12	VIw	39	IIIw-63	36	Lowland	42	III
Bm	Binton silty clay loam	13	VIIs	40	----	--	Saline Lowland	43	Unsuited
Bn	Binton silty clay loam, saline	13	VIIs	40	----	--	Saline Lowland	43	Unsuited
BoC	Birdsley clay loam, 0 to 10 percent slopes	13	VIIs	40	----	--	Alkali Uplands	45	Unsuited
BRC	Birdsley-Boysen complex, 0 to 10 percent slopes	13	VIIs	40	----	--	----	--	----
	Birdsley part	--	----	--	----	--	Alkali Uplands	45	Unsuited
	Boysen part	--	----	--	----	--	Alkali Uplands	45	Unsuited
	Meeteetse part	--	----	--	----	--	Alkali Uplands	45	Unsuited
	Pavillion part	--	----	--	----	--	Saline Upland	45	III
BSC	Birdsley-Pavillion association, sloping	13	VIIs	40	----	--	----	--	----
	Birdsley part	--	----	--	----	--	Alkali Uplands	45	Unsuited
	Pavillion part	--	----	--	----	--	Loamy	44	I
	Apron part	--	----	--	----	--	Sandy	44	Unsuited
ByB	Boysen sandy clay loam, 0 to 6 percent slopes	14	VIIs	40	----	--	Alkali Uplands	45	Unsuited
CgE	Clifterson gravelly loam, 10 to 30 percent slopes	14	VIe	38	----	--	Gravelly	44	II
GHE	Clifterson association, hilly	14	VIe	38	----	--	Gravelly	44	II

Map symbol	Mapping unit	Page	Capability subclass (Dryland) Symbol	Page	Capability unit (Irrigated) Symbol	Page	Range site Name	Page	Windbreak suitability group Number
CRF	Clifterson-Rock land association, steep	14	----	--	----	--	----	--	----
	Clifterson part	--	VIe	38	----	--	Gravelly	44	II
	Rock land part	--	VIIIs	40	----	--	Not assigned	--	Unsuited
	Oceanet part	--	VIIe	39	----	--	Shallow Sandy	45	Unsuited
	Persayo part	--	VIIe	39	----	--	Shallow Clayey	44	Unsuited
Cw	Crowheart loam	15	VIws	39	IIIws-11	37	Saline Sub-irrigated	42	III
Ef	Effington sandy clay loam	15	VIs	39	IVs-12	38	Alkali Uplands	45	III
Eg	Effington sandy clay loam, gravel substratum	16	VIs	39	IVs-12	38	Alkali Uplands	45	III
En	Effington sandy clay loam, wet	16	VIw	39	----	--	Saline Sub-irrigated	42	Unsuited
EP	Effington-Apron association	16	----	--	----	--	----	--	----
	Effington part	--	VIs	39	IVs-12	38	Alkali Uplands	45	III
	Apron part	--	VIe	39	IIe-5	33	Sandy	44	II
ESB	Enos-Wall association, gently sloping-	16	----	--	----	--	----	--	----
	Enos part	--	VIe	38	IVe-5	37	Sandy	44	II
	Wall part	--	VIe	38	IVe-4	37	Sandy	44	II
	Oceanet part	--	VIIe	39	VIe-14 1/	38	Shallow Sandy	45	Unsuited
	Rock land part	--	VIIIs	40	----	--	Not assigned	--	Unsuited
EtA	Ethete loam, 0 to 3 percent slopes	17	VIs	39	IIs-2	33	Loamy	44	I
EtB	Ethete loam, 3 to 6 percent slopes	18	VIe	38	IIIe-2	35	Loamy	44	I
EuB	Ethete loam, saline, 0 to 6 percent slopes	18	VIws	39	IIIws-11	37	Saline Sub-irrigated	42	III
FmA	Fivemile sandy clay loam, 0 to 3 percent slopes	19	VIc	39	IIc-16	34	Loamy	44	I
FnA	Fivemile silty clay loam, 0 to 3 percent slopes	18	VIIc	40	IIc-1	34	Saline Upland	45	I
FnB	Fivemile silty clay loam, 3 to 6 percent slopes	18	VIIe	39	IIIe-1	35	Saline Upland	45	I
FoB	Fivemile silty clay loam, saline, 0 to 6 percent slopes	18	VIws	39	IIIws-10	37	Saline Sub-irrigated	42	III
FrA	Fruita clay loam, 0 to 3 percent slopes	19	VIs	39	IVs-12	38	Alkali Uplands	45	III
FrB	Fruita clay loam, 3 to 6 percent slopes	19	VIe	38	IVs-12	38	Alkali Uplands	45	III
Gn	Glenton sandy loam	19	VIe	38	IIe-5	33	Lowland	42	II
GrA	Griffy loam, 0 to 3 percent slopes	20	VIc	39	IIc-16	34	Loamy	44	I
GrB	Griffy loam, 3 to 6 percent slopes	20	VIe	38	IIIe-2	35	Loamy	44	I
GrC	Griffy loam, 6 to 10 percent slopes	20	VIe	38	IVe-2	37	Loamy	44	I
Gu	Gullied land	20	VIIIe	40	----	--	Not assigned	--	III

Map symbol	Mapping unit	Page	Capability subclass Dryland Symbol	Page	Capability unit Irrigated Symbol	Page	Range site Name	Page	Windbreak suitability group Number
LoA	Lostwells sandy clay loam, 0 to 3 percent slopes	21	VIc	39	IIc-16	34	Loamy	44	I
LoB	Lostwells sandy clay loam, 3 to 6 percent slopes	21	VIe	38	IIIe-2	35	Loamy	44	I
LoC	Lostwells sandy clay loam, 6 to 10 percent slopes	21	VIe	38	IVe-2	37	Loamy	44	I
LsB	Lostwells sandy clay loam, alkali, 0 to 6 percent slopes	21	VIs	39	IVs-12	38	Saline Upland	45	III
LtB	Lostwells sandy clay loam, saline, 0 to 6 percent slopes	22	VIws	39	IIIws-10	37	Saline Sub-irrigated	42	III
Ma	Marsh	22	VIIIw	40	----	--	Not assigned	--	Unsuited
MdB	Meeteetse loamy sand, 0 to 6 percent slopes	22	VIe	38	----	--	Sandy	44	Unsuited
MEB	Meeteetse soils, 0 to 6 percent slopes	22	VIIs	40	----	--	----	--	----
	Meeteetse loamy sand	--	----	--	----	--	Sandy	44	Unsuited
	Meeteetse sandy clay loam	--	----	--	----	--	Alkali Uplands	45	Unsuited
MmB	Mudray-Meeteetse loamy sands, 0 to 6 percent slopes	23	VIIs	40	----	--	----	--	----
	Mudray part	--	----	--	----	--	Shallow Sandy	45	Unsuited
	Meeteetse part	--	----	--	----	--	Sandy	44	Unsuited
MtB	Mudray-Meeteetse sandy clay loams, 0 to 6 percent slopes	23	VIIs	40	----	--	Alkali Uplands	45	Unsuited
OcC	Oceanet sandy loam, 0 to 10 percent slopes	23	VIIe	39	----	--	Shallow Sandy	45	Unsuited
ORE	Oceanet-Rock land association, hilly	23	----	--	----	--	----	--	----
	Oceanet part	--	VIIe	39	----	--	Shallow Sandy	45	Unsuited
	Rock land part	--	VIIIs	40	----	--	Not assigned	--	Unsuited
PaA	Pavillion sandy clay loam, 0 to 3 percent slopes	24	VIs	39	IVs-2	37	Loamy	44	I
PaC	Pavillion sandy clay loam, 3 to 10 percent slopes	24	VIe	38	IVe-2	37	Loamy	44	I
PcB	Pavillion sandy clay loam, alkali, 0 to 6 percent slopes	24	VIs	39	IVs-12	38	Saline Upland	45	III
PeE	Persayo sandy clay loam, 0 to 30 percent slopes	24	VIIe	39	VIe-14 [1/]	38	Shallow Clayey	44	Unsuited
POD	Persayo-Oceanet association, steep	24	----	--	----	--	----	--	----
	Persayo part	--	VIIe	39	----	--	Shallow Clayey	44	Unsuited
	Oceanet part	--	VIIe	39	----	--	Shallow Sandy	45	Unsuited
	Rock land part	--	VIIIs	40	----	--	Not assigned	--	Unsuited

Map symbol	Mapping unit	Page	Capability subclass (Dryland) Symbol	Page	Capability unit (Irrigated) Symbol	Page	Range site Name	Page	Windbreak suitability group Number
PRE	Persayo-Worland association, hilly----	25	----	--	----	--	----	--	----
	Persayo part----------	--	VIIe	39	----	--	Shallow Clayey	44	Unsuited
	Worland part----------	--	VIe	38	----	--	Sandy	44	II
	Oceanet part----------	--	VIIe	39	----	--	Shallow Sandy	45	Unsuited
	Rock land part----------	--	VIIIs	40	----	--	Not assigned	--	Unsuited
RS	Rock land----------	25	VIIIs	40	----	--	Not assigned	--	Unsuited
SaA	Saddle sandy clay loam, 0 to 3 percent slopes----------	26	VIs	39	IVs-2	37	Loamy	44	I
SaC	Saddle sandy clay loam, 3 to 10 percent slopes----------	25	VIe	38	IVe-2	37	Loamy	44	I
Sw	Saline wet land----------	26	VIws	39	VIs-71	38	Saline Sub-irrigated	42	Unsuited
TcA	Teapo sandy clay loam, 0 to 3 percent slopes----------	26	VIs	39	IVs-2	37	Loamy	44	I
TcB	Teapo sandy clay loam, 3 to 6 percent slopes----------	26	VIe	38	IVe-2	37	Loamy	44	I
TeB	Teapo sandy clay loam, saline, 0 to 6 percent slopes----------	26	VIws	39	IVws-10	38	Saline Sub-irrigated	42	III
TmB	Tipperary loamy sand, 0 to 6 percent slopes----------	27	VIe	38	IVe-15	37	Sands	44	II
TmC	Tipperary loamy sand, 6 to 10 percent slopes----------	27	VIe	38	----	--	Sands	44	II
TnD	Tipperary loamy sand, alkali, hummocky----------	27	VIIs	40	----	--	Saline Lowland	43	Unsuited
TOE	Tipperary-Tipper association, hilly---	27	----	--	----	--	----	--	----
	Tipperary part----------	--	VIe	38	----	--	Sands	44	II
	Tipper part----------	--	VIe	38	----	--	Sands	44	II
	Oceanet part----------	--	VIIe	39	----	--	Shallow Sandy	45	Unsuited
TRE	Tipperary-Trook association, hilly----	27	----	--	----	--	----	--	----
	Tipperary part----------	--	VIe	38	----	--	Sands	44	II
	Trook part----------	--	VIe	38	----	--	Sandy	44	II
TsA	Trook sandy loam, 0 to 3 percent slopes----------	28	VIe	38	IIe-5	33	Sandy	44	II
TsB	Trook sandy loam, 3 to 6 percent slopes----------	28	VIe	38	IIIe-5	36	Sandy	44	II
TsC	Trook sandy loam, 6 to 10 percent slopes----------	28	VIe	38	IVe-5	37	Sandy	44	II
TtB	Trook sandy loam, saline, 0 to 6 percent slopes----------	28	VIws	39	IIIws-11	37	Saline Sub-irrigated	42	III
TUB	Trook-Apron association, gently sloping----------	28	VIe	38	----	--	Sandy	44	II

Map symbol	Mapping unit	Page	Capability subclass (Dryland) Symbol	Page	Capability unit (Irrigated) Symbol	Page	Range site Name	Page	Windbreak suitability group Number
TVD	Trook-Clifterson association, moderately steep	28	----	--	----	--	----	--	----
	Trook part	--	VIe	38	----	--	Sandy	44	II
	Clifterson part	--	VIe	38	----	--	Gravelly	44	II
	Apron part	--	VIe	38	----	--	Sandy	44	II
	Persayo part	--	VIIe	39	----	--	Shallow Clayey	44	Unsuited
Wa	Wet alluvial land	29	VIw	39	----	--	Wetland	41	Unsuited
Wc	Winkleman silty clay	29	VIs	39	IIIs-1	36	Not assigned	--	III
We	Winkleman silty clay, saline	30	VIws	39	VIws-10	38	Not assigned	--	III
Wk	Winkleman silty clay, wet	30	VIw	39	----	--	Not assigned	--	Unsuited
WoA	Worland sandy loam, 0 to 3 percent slopes	30	VIe	38	IVe-5	37	Sandy	44	II
WoB	Worland sandy loam, 3 to 6 percent slopes	30	VIe	38	IVe-5	37	Sandy	44	II
WoC	Worland sandy loam, 6 to 10 percent slopes	30	VIe	38	IVe-5	37	Sandy	44	II
WrB	Worland sandy loam, saline, 0 to 6 percent slopes	30	VIws	39	IVws-10	38	Saline Sub-irrigated	42	III
WSC	Worland-Oceanet complex, 0 to 10 percent slopes	30	VIIe	39	----	--	----	--	----
	Worland part	--	----	--	----	--	Sandy	44	II
	Oceanet part	--	----	--	----	--	Shallow Sandy	44	Unsuited
	Rock land part	--	----	--	----	--	Not assigned	--	Unsuited
Yo	Youngston clay loam	31	VIe	38	IIc-1	34	Clayey	44	

1/ Suitability of this unit for irrigation (capability unit VIe-14, irrigated) is limited to places where slopes are 0 to 15 percent.

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