United States Department of Agriculture

Soil Conservation Service

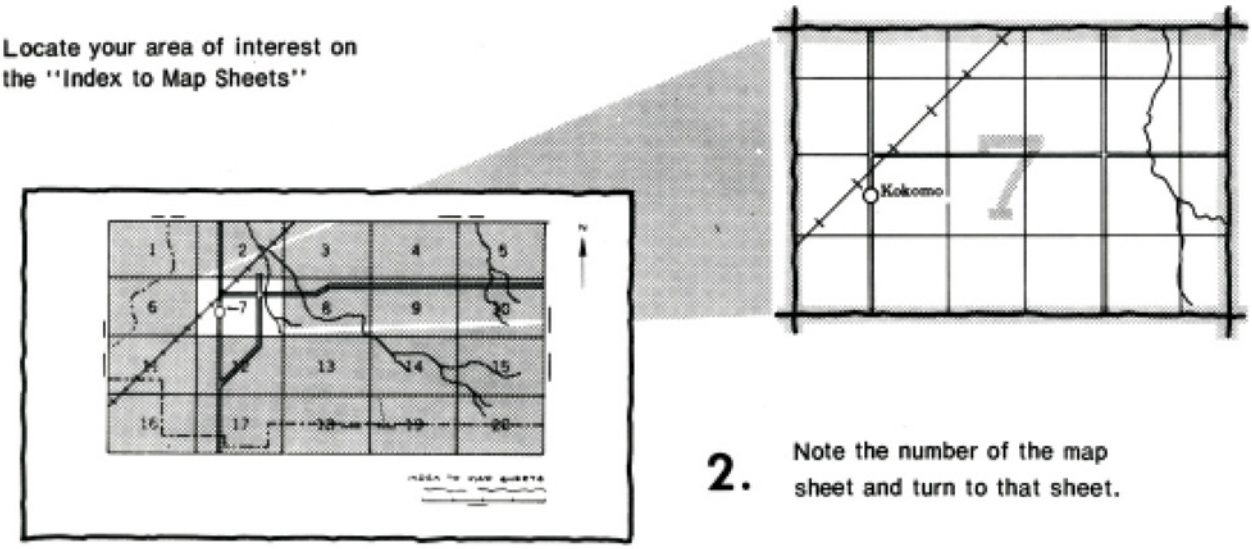
In cooperation with United States Department of Agriculture, Forest Service; United States Department of the Interior, Bureau of Land Management; and Wyoming Agricultural Experiment Station

Soil Survey of Converse County, Wyoming,

Northern Part

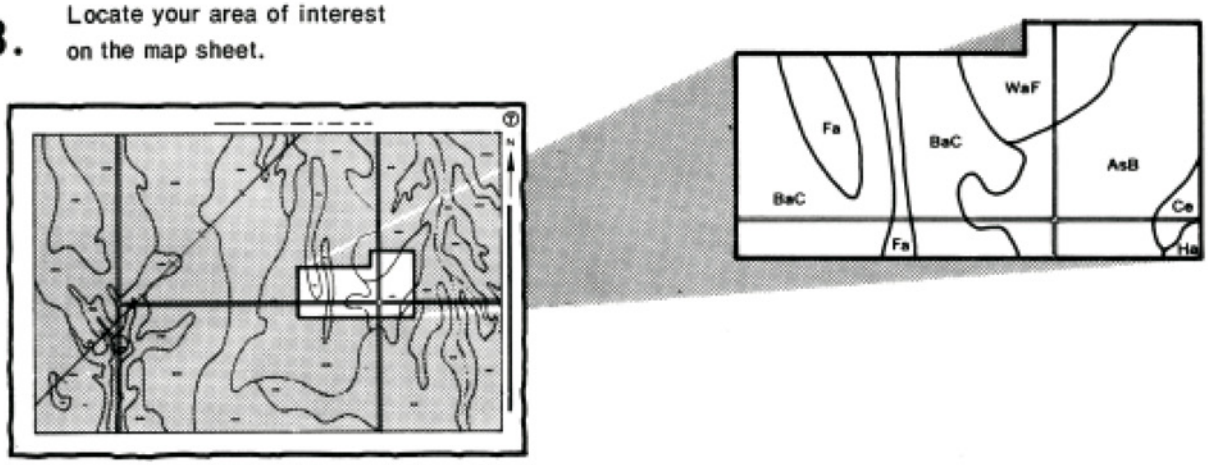
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

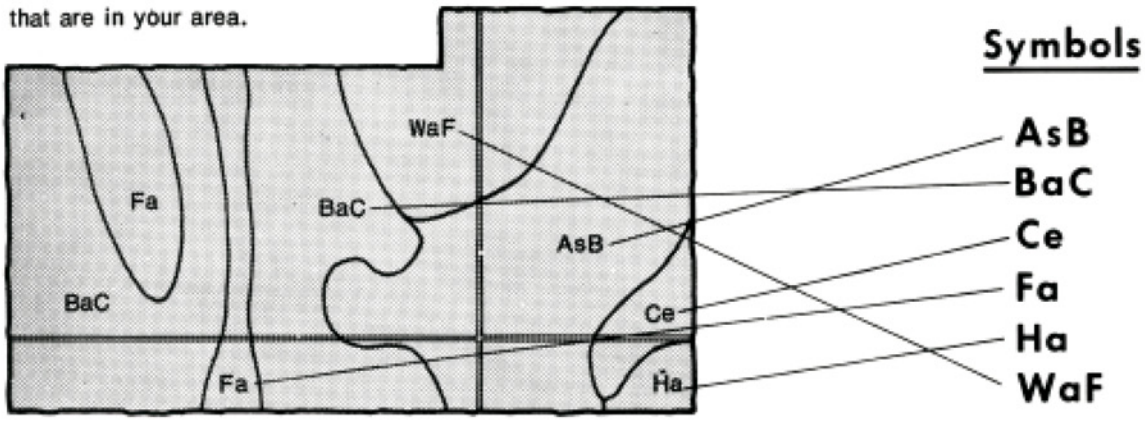


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

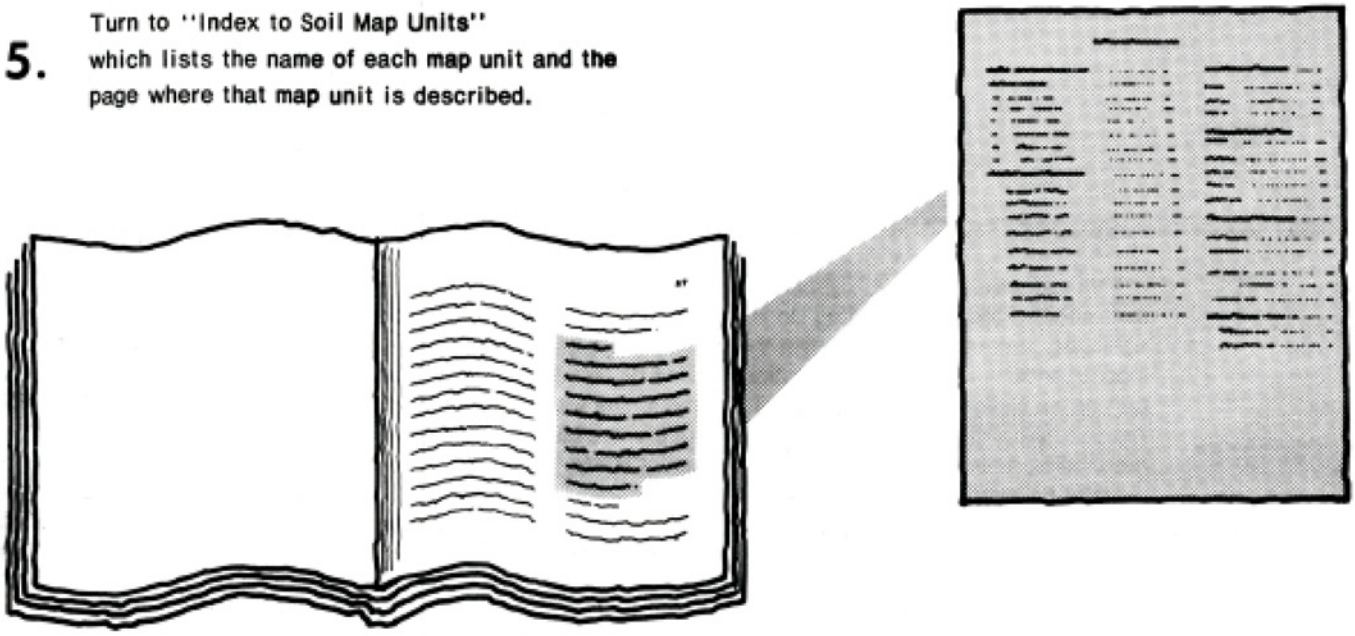


4. List the map unit symbols that are in your area.

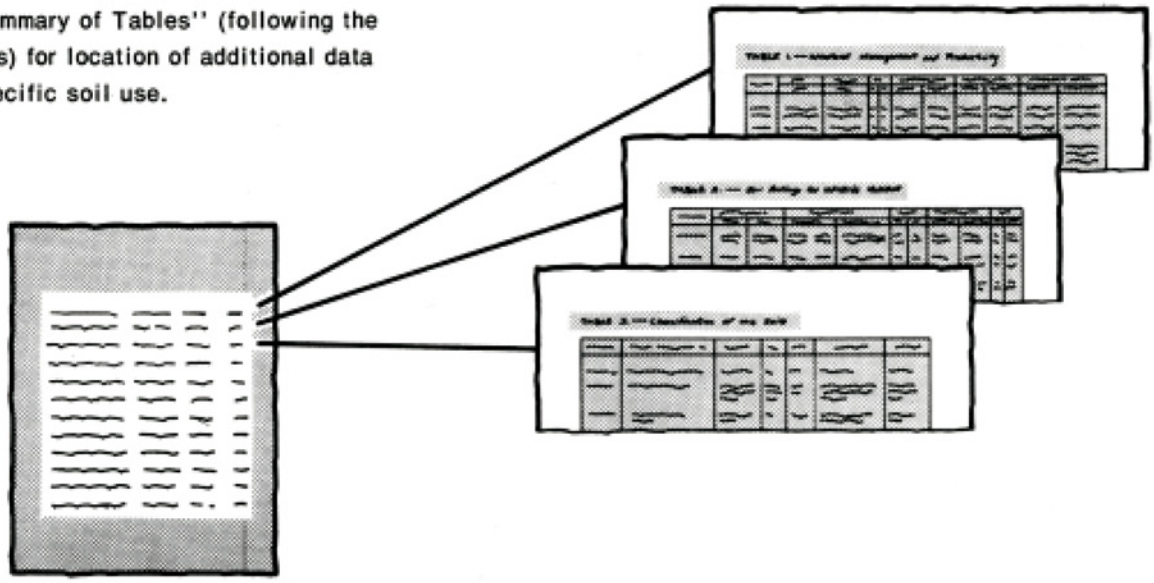


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major field work for this soil survey was completed in 1982. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, the Bureau of Land Management, and the Wyoming Agricultural Experiment Station. It is part of the technical assistance furnished to the Converse County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: View of the Miller Hills from Cow Creek Buttes.

Contents

Taxonomic Units

Index to Map Units

Summary of Tables

Foreword

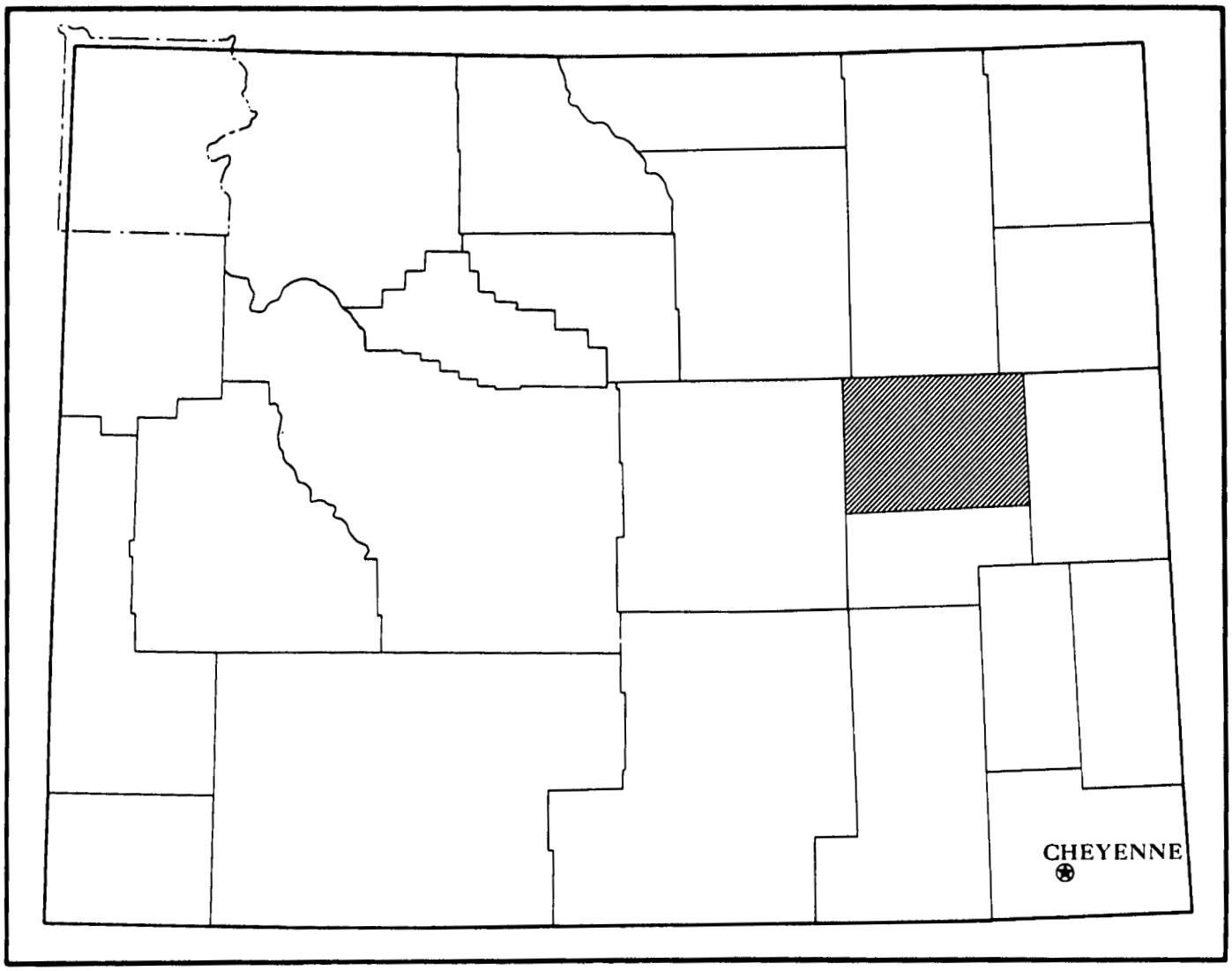
This soil survey contains information that can be used in land-planning programs in Converse County, Wyoming, Northern Part. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations,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

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

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

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

Frank S. Dickson, Jr.
State Conservationist
Soil Conservation Service



Location of Converse County, Northern Part, in Wyoming.

Soil Survey of Converse County, Wyoming Northern Part

By Ronald L. Reckner, Soil Conservation Service

Fieldwork by Shawn M. Finn, Frank L. Nelson, Ronald L. Reckner, Janet M. Scalamandre, and Donald G. Wetterauer, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with
United States Department of Agriculture, Forest Service; United States Department of the Interior, Bureau of Land Management; and Wyoming Agricultural Experiment Station

CONVERSE COUNTY, NORTHERN PART, comprises roughly the northern one-half of Converse County. The survey area is at the southern end of the Powder River Basin, in the high plains. It is about 59 miles long and 38 miles wide. The total area is about 2,227 square miles, or 1,425,558 acres. The Dry Fork of the Cheyenne River drains most of the survey area.

Agriculture in the survey area is characterized by cattle and sheep production. Less than 2,000 acres is used for small grain and alfalfa hay. Oil, natural gas, coal, and uranium are important energy resources being developed in the area. The area provides habitat for a large population of pronghorn antelope. Hunting and tourism are important economic enterprises.

This soil survey was made largely to satisfy the demands for resource information brought about by rapid energy development. The map unit descriptions in the section "Detailed Soil Map Units" were designed for the needs of ranching and reclamation. The soil maps are suitable for making grazing management decisions, and they are intended to be a starting point for more detailed reclamation studies.

About 8,000 acres, mostly in T. 39 N., Rs. 72 and 73 W., was not mapped because access was denied.

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

General Nature of the Survey Area

This section gives general information about the survey area. It discusses climate; physiography, relief, and drainage; history and development; and natural resources and land use.

Climate

Prepared by the Wyoming Agricultural Experiment Station from data provided by the Department of Atmospheric Science, University of Wyoming.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Dull Center in the period 1952-70. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring.

In winter, the average temperature is 25 degrees F and the average daily minimum temperature is 12 degrees. The lowest temperature on record, which occurred at Dull Center, is -49 degrees. In summer, the average temperature is 69 degrees and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred at Dull Center, is 111 degrees.

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

The total annual precipitation is 12.30 inches. Of this, 9.76 inches, or 79 percent, usually falls in April through September. The growing season for most crops falls within this period. The growing season length, as recorded in the period 1952-70 at Dull Center, was 167 days on the basis of a daily minimum temperature of more than 24 degrees; 146 days more than 28 degrees; and 125 days more than 32 degrees.

The rainfall erosion index (R factor) for applying the Universal Soil Loss Equation is about 35 in the central part of Converse County. It increases somewhat in areas toward the east and decreases in areas toward the west. The Universal Soil Loss Equation is useful in planning resource management systems to control sheet and rill erosion.

Physiography, Relief, and Drainage

John S. Moore, geologist, Soil Conservation Service, assisted in the preparation of this section.

The survey area is in the southern part of the northern rolling high plains. The area is at the southern end of the Powder River Basin, which is between the Casper Arch and the Big Horn Mountains to the west and the Black Hills to the northeast. The survey area is underlain by interbedded sandstone and shale. Most of the beds are nearly flat, but they have low dips toward the center of the area.

Erosion has produced a terrain characterized by broad tablelands and wide, shallow valleys. The tablelands commonly are underlain by the somewhat more resistant sandstone members. Stream patterns are primarily dendritic and exhibit little structural control. In the central part of the survey area, where the Wasatch Formation crops out, the relief is more subdued than that of the Lance and Fort Union Formations, and shallow basins with internal drainage are common. Nearly all streams are ephemeral, and streamflow is dependent upon local climatic conditions (*3*).

Resistant beds of sandstone or porcellanite that cap more erodible shale commonly form conspicuous upland ridges, or buttes. Examples of porcellanite-capped uplands in the northeastern part of the county include the Rochelle Hills, the Red Hills, and the Cow Creek Buttes. Blizzard Heights and the Cheyenne River Divide are examples of sandstone-controlled uplands in the west-central part of the county. Pine Ridge escarpment is a prominent topographic feature on the western side of the county, where erosion into badland topography is common (fig. 1). Dilts Flat, Ross Flat, and Highland Flats are distinctive upland divides.

The maximum relief in the survey area is 2,040 feet. Elevation ranges from 4,275 to 6,315 feet. Locally, the relief averages 250 feet or less, measured from the flood plains of stream channels to the tops of adjacent ridges.

Streams in the survey area flow into three drainage basins. Streams in the northern and eastern parts, including the Dry Fork of the Cheyenne River and Wind, Antelope, Sand, Bear, Dry, Box, Lightning, Walker, and Twenty-mile Creeks, flow northeastward into the Cheyenne River. Streams to the south flow into the North Platte River. These include Cole, Sand, and Sage Creeks. In the extreme northwestern corner of the area, the streams are tributaries of the Powder River.

History and Development

Converse County was established from parts of Albany and Laramie Counties on March 9, 1888, and was named after the territorial treasurer in office at that time.

The area that is now Converse County served as periodic hunting grounds for Native Americans before the westward migration of white men. The first to arrive were explorers, trappers, traders, and settlers that traveled along the North Platte River, following routes that later became the Mormon and Oregon Trails, the Overland Stage route, the Pony Express route, and the first transcontinental telegraph line.

Fort Fetterman was established in 1867 on a plateau above the North Platte River, where the Bozeman Trail left the Oregon Trail enroute to the Montana gold fields. With the advance of the railroad in 1886 came the first major influx of permanent settlers into the survey area. A townsite was established about 10 miles downstream from the fort. The town of Douglas, named after the famous orator, Stephen A. Douglas, was incorporated in 1887. Many homesteads were settled in the early 1900's as a result of the Homestead Acts of 1862, 1909, 1912, and 1916.

Douglas, the principal town and county seat, now serves as the major market and business center. Glenrock, a smaller town, is the industrial center in the county. Shawnee, Lost Springs, Bill, and Orin are smaller communities in the county. Bill, the only community in the survey area, has a large coal car repair facility.

Transportation is available from commercial air operations in Casper and a bus stop in Douglas. The area is served by Interstate Highway 25, which crosses

Figure 1.—An area of Pine Ridge escarpment. Gateson Variant and Tassel Variant soils are on ridgetops, shoulders, and north-facing back slopes. Clarkelen and Draknab soils are on the bottom lands. Shingle, Worf, and Hiland soils are commonly in the intermediate areas.

the county east and west, passing through Douglas. There are also two U.S. highways and three state highways, one of which connects Douglas with Gillette. Two railroads—one ships freight and cattle and the other ships coal—pass through the county.

Energy development in the northern part of Converse County during the 1970's led to an increase in the populations of Douglas, Glenrock, Casper, and Gillette.

Natural Resources and Land Use

Soil and the vegetation it supports are the most extensive resources in the survey area. About 93 percent of the area, or 1,333,500 acres, is rangeland. Winters without long-term accumulations of snow commonly allow livestock grazing year round with little supplemental feeding. The survey area has about 100 ranches that average 12,800 acres, but a few are more than 50,000 acres (*8*). Most ranches are both cattle and sheep operations.

About 190,000 acres is National Grassland, which is administered by the Forest Service under a permit system for grazing and mineral development. About 100,000 acres is grazed under the administration of the Bureau of Land Management. Another 100,000 acres is state-administered land that is leased for grazing.

Water is scarce in the area. It is mostly in intermittent streams and is stored in small reservoirs for ranch use, primarily for livestock consumption. Windmills with

livestock watering tanks supplement the surface water supply.

The Powder River Basin is a region of extensive exploration and development of energy resources. The Glenrock Coal Mine produces coal for the Dave Johnston Power Plant, a few miles east of Glenrock. Tracts are also being leased for coal development in the northeastern part of the county.

Several uranium mining operations are in the county. These operations are centered around Highland Flats and the Cheyenne River Divide. Exxon and Bear Creek mines are the larger operations.

Oil and gas have been produced in the county since the early 1900's, and production and exploration continue today. Numerous oil and gas fields are in the survey area. Some of the larger fields are east of Highland Flats, along Walker Creek, and between the towns of Bill and Dull Center.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; slopes described as short generally are less than 50 yards, and slopes described as long generally are more than 150 yards. They also observed the general pattern of drainage, the kinds of crops and native plants, and the kinds of bedrock. The soil scientists dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge gradually onto one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While the soil survey was in progress, samples of some of the soils in the area were collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses and under different levels of management. Some interpretations were modified to fit local conditions, and some new interpretations were developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries.

General Soil Map Units

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

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

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

The general map units in this survey are described in the following pages.

Map Unit Descriptions

1. Clarkelen-Haverdad-Draknab

Deep, well drained to excessively drained, nearly level to undulating soils; on flood plains and low terraces

This map unit is in the northeastern corner of the survey area. It is on flood plains and low terraces along Antelope Creek and Dry Fork of the Cheyenne River. Slope is 0 to 6 percent. The vegetation is mainly grasses, shrubs, cottonwood trees, and forbs.

This unit makes up about 3 percent of the survey area. It is about 40 percent Clarkelen soils, 30 percent Haverdad soils, and 10 percent Draknab soils. The remaining 20 percent is components of minor extent.

Clarkelen soils are on flood plains and low terraces. These soils are somewhat excessively drained. They formed in stratified alluvium derived dominantly from sedimentary rock. The surface layer is moderately coarse textured. Below this to a depth of 60 inches or more the soils are stratified in coarse to moderately fine textures.

Haverdad soils are on flood plains. These soils are well drained. They formed in stratified alluvium derived dominantly from sedimentary rock. The surface layer is moderately coarse textured. Below this to a depth of 60 inches or more the soils are stratified in coarse to moderately fine textures.

Draknab soils are on flood plains. These soils are excessively drained. They formed in stratified alluvium derived dominantly from sedimentary rock. The soils are coarse textured throughout.

Of minor extent in this unit are the Absted, Arvada, and Bone soils that are salt- and alkali-affected.

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas are used for native hay production in some years.

The main limitations for native hay production are the hazard of flooding and the areas of salt- and alkali-affected soils. Access by roads and trails generally is good in this unit. Short road segments may be washed out during severe flooding, and the more nearly level areas that have a clayey surface layer may be impassable when wet.

2. Forkwood-Cushman-Hiland

Deep and moderately deep, well drained, nearly level to rolling soils; on uplands

This map unit is mainly west of Wyoming Highway 59, along the middle reaches of Dry Fork of the Cheyenne River and the upper reaches of Box Creek. Slope is 0 to 15 percent. The vegetation is mainly grasses, forbs, and shrubs.

This unit makes up about 8 percent of the survey area. It is about 40 percent Forkwood soils, 10 percent Cushman soils, and 10 percent Hiland soils. The remaining 40 percent is components of minor extent.

Forkwood soils are on foot slopes and toe slopes of uplands. These soils are deep. They formed in local alluvium derived dominantly from sedimentary rock. The surface layer is moderately coarse textured. The subsoil to a depth of 60 inches or more is moderately fine textured.

Cushman soils are on ridges and back slopes of uplands. These soils are moderately deep and well drained. They formed in residuum derived dominantly from sedimentary rock. The surface layer is medium textured. The subsoil is moderately fine textured and medium textured to a depth of 25 inches. Weathered shale is at a depth of 25 inches.

Hiland soils are on back slopes and foot slopes of uplands. These soils are deep and well drained. They formed in residuum derived dominantly from sedimentary rock. The surface layer is moderately coarse textured. The subsoil to a depth of 60 inches or more is moderately coarse textured to moderately fine textured.

Of minor extent in this unit are shallow Shingle and Worf soils in the steeper areas on ridges and back slopes and deep Ulm and Cambria soils on foot slopes.

This unit is used mainly for livestock grazing and wildlife habitat. It is also used for oil production in the Highland Flats area. Small areas of level to undulating soils have been used for nonirrigated small grain with little success.

The main limitation of this unit for forage and small grain production is low annual precipitation. Access by improved roads and trails is generally good in this unit.

3. Dwyer-Orpha

Deep, excessively drained, undulating to rolling soils; on ridges and dunes

This map unit is in the southwestern part of the survey area. The unit is characterized by rolling dune areas of wind-deposited sand. Slope is 3 to 15 percent. The vegetation is mainly grasses and forbs.

This unit makes up about 3 percent of the survey area. It is about 40 percent Dwyer soils and 30 percent Orpha soils. The remaining 30 percent is components of minor extent.

Dwyer soils are on ridges and dunes. These soils are calcareous. They formed in calcareous eolian sand derived from mixed sources. The soils are coarse textured throughout.

Orpha soils are on ridges and dunes. These soils are noncalcareous. They formed in eolian sand derived from mixed sources. The soils are coarse textured throughout.

Of minor extent in this unit are the well drained Hiland soils and the somewhat excessively drained Vonalee soils on foot slopes and the well drained and moderately deep and shallow Bowbac and Tassel soils on back slopes and ridges, upon which the dunes are encroaching.

This unit is used for livestock grazing and wildlife habitat.

The main limitations of the unit for forage production are droughtiness and the hazard of wind erosion. Access by improved roads is fair; trails are subject to sand blowing.

4. Shingle-Wibaux-Rock outcrop

Shallow, well drained and somewhat excessively drained, rolling to steep soils, and Rock outcrop; on uplands

This map unit is in the northern part of the survey area. It is on dissected uplands along Antelope Creek and Dry Fork of the Cheyenne River, east of Wyoming Highway 59. This unit is characterized by steep shale escarpments with thin coal and sodic shale seams and by hilly upland remnants capped with porcellanite beds. Slope is 6 to 45 percent. The vegetation is mainly grasses, forbs, shrubs, and some conifers.

This unit makes up about 3 percent of the survey area. It is about 35 percent Shingle soils, 20 percent Wibaux soils, and 15 percent Rock outcrop. The remaining 30 percent is components of minor extent.

Shingle soils are on hills and summits. These soils are well drained. They formed in residuum derived dominantly from shale. The soils are moderately fine textured and are underlain by weathered shale at a depth of 18 inches.

Wibaux soils are on ridges and upper hill slopes. These soils are somewhat excessively drained. They have a thin mantle of soil material over rock fragments. These soils formed in residuum derived dominantly from porcellanite. The soils are medium textured and are underlain by fractured porcellanite at a depth of 11 inches.

Rock outcrop consists of areas of exposed shale, porcellanite, siltstone, and sandstone on ridge crests and escarpments and in deeply incised gullies.

Of minor extent in this unit are shallow Samday and Worf soils and very shallow Sear soils on ridges and hillsides.

This unit is used for livestock grazing and wildlife habitat. The main limitations for forage production are depth to bedrock and droughtiness.

Access to this unit is limited because improved roads generally are constructed only along the major drainageways. Trails are subject to severe erosion.

5. Tassel-Hiland-Vonalee

Shallow and deep, well drained and somewhat excessively drained, undulating to hilly soils; on uplands

This map unit is in the western part of the survey area. It begins just south of the Campbell County line and extends south over the Cheyenne River Divide and Blizzard Heights to the survey area boundary. Slope is 3 to 30 percent. The vegetation is mainly grasses, forbs, and shrubs.

This unit makes up about 21 percent of the survey area. It is about 25 percent Tassel soils, 20 percent Hiland soils, and 20 percent Vonalee soils. The remaining 35 percent is components of minor extent.

Tassel soils are on ridgetops and shoulder slopes. These soils are shallow and well drained. They formed in residuum derived dominantly from sandstone. The surface layer is coarse textured. The underlying material is moderately coarse textured. Weathered sandstone is at a depth of 16 inches.

Hiland soils are on back slopes and foot slopes. These soils are deep and well drained. They formed in residuum and local alluvium derived dominantly from sedimentary rock. The surface layer is moderately

coarse textured. The subsoil to a depth of 60 inches or more is moderately coarse textured to moderately fine textured.

Vonalee soils are on ridges and hill slopes. These soils are deep and somewhat excessively drained. They formed in eolian sand and wind-worked residuum derived dominantly from sandstone. The surface layer is coarse textured. The subsoil to a depth of 60 inches or more is coarse textured to medium textured.

Of minor extent in this unit are moderately deep Bowbac and Tullock soils.

This unit is used for livestock grazing and wildlife habitat. Several uranium mines are in operation on the unit.

The main limitation for forage production is low annual precipitation. Paved roads, improved dirt roads, and trails provide good access to this unit.

6. Shingle-Cushman-Bowbac

Shallow and moderately deep, well drained, rolling and hilly soils; on uplands

This map unit is just west of the southern tip of Pine Ridge and along the upper reaches of Antelope Creek. Slope is 6 to 30 percent. The vegetation is mainly grasses, forbs, and shrubs.

This unit makes up about 6 percent of the survey area. It is about 20 percent Shingle soils, 15 percent Cushman soils, and 20 percent Bowbac soils. The remaining 45 percent is components of minor extent.

Shingle soils are on ridgetops and back slopes. These soils are shallow. They formed in residuum derived dominantly from shale. The soils are moderately fine textured throughout. Weathered shale is at a depth of 18 inches.

Cushman soils are on ridges, back slopes, and pediment slopes. These soils are moderately deep. They formed in residuum derived dominantly from sedimentary rock. The surface layer is medium textured. The subsoil to a depth of 25 inches is moderately fine textured and medium textured. Weathered sedimentary rock is at a depth of 25 inches.

Bowbac soils are on ridges, back slopes, and pediment slopes. These soils are moderately deep and well drained. They formed in residuum derived dominantly from sedimentary rock. The surface layer is moderately coarse textured. The subsoil to a depth of 36 inches is moderately fine textured to moderately coarse textured. Weathered sedimentary rock is at a depth of 36 inches.

Of minor extent in this unit are shallow Tassel and Samday soils and deep Cambria and Forkwood soils. The Forkwood soils are on foot slopes and toe slopes. The Cambria, Tassel, and Samday soils are on ridges and back slopes.

This unit is used for livestock grazing and wildlife habitat.

The main limitation of the unit for forage production is restricted rooting depth. Access by roads is limited.

7. Hiland-Shingle-Ulm

Deep and shallow, well drained, nearly level to hilly soils; on uplands and adjacent foot slopes, toe slopes, and alluvial flats

This map unit is in areas of dissected uplands throughout the survey area. Slope is 0 to 30 percent. The vegetation is mainly grasses, forbs, and shrubs.

This unit makes up about 27 percent of the survey area. It is about 30 percent Hiland soils, 15 percent Shingle soils, and 10 percent Ulm soils. The remaining 45 percent is components of minor extent.

Hiland soils are on back slopes and foot slopes. These soils are deep. They formed in residuum and local alluvium derived dominantly from sedimentary rock. The surface layer is moderately coarse textured. The subsoil to a depth of 60 inches or more is moderately coarse textured to moderately fine textured.

Shingle soils are on ridges and back slopes. These soils are shallow. They formed in residuum derived dominantly from shale. The soils are moderately fine textured throughout. Weathered shale is at a depth of 18 inches.

Ulm soils are on toe slopes and alluvial flats. These soils are deep. They formed in alluvium derived dominantly from shale. The surface layer is medium textured. The subsoil to a depth of 60 inches or more is moderately fine textured.

Of minor extent in this unit are moderately deep Bowbac soils and shallow Tassel and Worf soils. The Bowbac soils are on back slopes and pediment slopes. The Tassel and Worf soils are on ridges.

This unit is used mainly for livestock grazing and wildlife habitat. Several large oil fields have been developed on the unit, and several uranium mines are operated in the Highland Flats area.

The main limitation of this unit for forage production is low annual precipitation. Access by roads and trails generally is good.

8. Ulm-Bidman-Renohill

Deep and moderately deep, well drained, nearly level to hilly soils; on uplands and adjacent foot slopes, toe slopes, and alluvial flats

This map unit is in areas around Highland Flats and Dilts Flat and in the eastern part of the survey area. Slope is 0 to 30 percent. The vegetation on this unit is mainly grasses, forbs, and shrubs.

This unit makes up about 12 percent of the survey area. It is about 30 percent Ulm soils, 20 percent Bidman soils, and 20 percent Renohill soils. The remaining 30 percent is components of minor extent.

Ulm soils are on foot slopes and toe slopes. These soils are deep and well drained. They formed in

residuum and local alluvium derived dominantly from shale. The surface layer is medium textured. The subsoil to a depth of 60 inches or more is moderately fine textured and fine textured.

Bidman soils are on foot slopes and toe slopes. These soils are deep and well drained. They formed in local alluvium derived dominantly from shale. The surface layer is moderately coarse textured. The subsoil is moderately fine textured and fine textured. Below this to a depth of 60 inches or more the soils are moderately fine textured.

Renohill soils are on back slopes and foot slopes. These soils are moderately deep and well drained. They formed in residuum derived dominantly from shale. The surface layer is moderately coarse textured. The subsoil is moderately fine textured and fine textured. Weathered shale is at a depth of 36 inches.

Of minor extent in this unit are shallow Samday, Shingle, Worf, and Worfka soils and deep Absted soils. The Samday, Shingle, Worf, and Worfka soils are on ridges. The Absted soils are salt- and alkali-affected and are on toe slopes and terraces.

This unit is used mainly for livestock grazing and wildlife habitat. A few localized areas of this unit that are less sloping and receive more precipitation are used for nonirrigated crops.

The main limitations of this unit for forage production are low annual precipitation and slow permeability. Some fields need to be seeded to grass. Access by roads and trails is good.

9. Shingle-Rock outcrop-Samday

Shallow, well drained, undulating to steep soils, and Rock outcrop; on uplands

This map unit is mainly east of Wyoming Highway 59, on dissected uplands near major drainageways, and in a large area on Pine Ridge, near the western boundary of the survey area. This unit is characterized by deeply incised gullies and exposures of sedimentary rock outcroppings. Slope is 3 to 45 percent. The vegetation on this unit is mainly grasses, forbs, shrubs, and scattered conifers.

This unit makes up about 17 percent of the survey area. It is about 30 percent Shingle soils, 20 percent Rock outcrop, and 20 percent Samday soils. The remaining 30 percent is components of minor extent.

Shingle soils are on ridges and hill slopes. These soils formed in residuum derived dominantly from shale. They are moderately fine textured throughout. Weathered shale is at a depth of 18 inches.

Rock outcrop consists of areas of exposed shale and a few areas of exposed siltstone and sandstone. These areas are on ridges and escarpments and in deeply incised gullies.

Samday soils are on hill slopes and ridges. These soils are shallow and well drained. They formed in residuum derived dominantly from shale. The surface layer is moderately fine textured. Weathered shale is at a depth of 18 inches.

Of minor extent in this unit are shallow Orella, Worf, and Tassel soils, deep Kishona soils, and moderately deep Theedle soil. The Orella soils are salt- and alkali-affected and are on less sloping back slopes. The Worf soils are on back slopes. The Tassel soils are on ridgetops and are derived from sandstone. The Kishona and Theedle soils are on foot slopes and pediment slopes.

This unit is used for livestock grazing and wildlife habitat. Several oil fields are in the unit.

The main limitation of this unit for forage production is limited rooting depth. Improved road access is very limited, and many trails throughout the unit have been severely eroded or washed out.

Detailed Soil Map Units

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

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavior divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

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

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Shingle loam, thin solum, is one of several phases in the Shingle series.

Most map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Ulm-Renohill complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or

miscellaneous areas are somewhat similar. Zigweid-Cambria association, 0 to 6 percent slopes, is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 3 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

101—Absted-Arvada-Bone complex, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on toe slopes, alluvial flats, and stream terraces. Slopes are medium in length and are plane. The native vegetation is mainly salt tolerant grasses, shrubs, and woody plants.

This unit is 40 percent Absted fine sandy loam, 25 percent Arvada loam, and 20 percent Bone clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ulm loam, Lohmiller clay loam, Haverdad fine sandy loam, and Bahl clay. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Absted soil is deep and well drained. It formed in clayey alluvium derived dominantly from sedimentary rock. Typically, the surface layer is pale brown fine sandy loam about 3 inches thick. The upper 23 inches of the subsoil is brown and grayish brown clay, and the lower 34 inches or more is light brownish gray clay. In a few areas soft bedrock is at a depth of 20 to 60 inches.

Permeability of the Absted soil is slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. Excess sodium or soluble salts are at an average depth of 15 inches.

The Arvada soil is deep and well drained. It formed in clayey alluvium derived dominantly from sedimentary rock. Typically, the surface layer is light brownish gray loam about 3 inches thick. The subsoil is pale brown and light brownish gray clay about 19 inches thick. The substratum to a depth of 60 inches or more is pale brown clay.

Permeability of the Arvada soil is very slow. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. Excess sodium or soluble salts are in the upper part of the subsoil.

The Bone soil is deep and well drained. It formed in clayey alluvium derived dominantly from sedimentary rock. Typically, the surface layer is pale brown clay loam about 2 inches thick. The upper 3 inches of the subsoil is light brownish gray clay loam, and the lower 5 inches is light gray clay loam. The substratum to a depth of 60 inches or more is very pale brown clay loam and clay.

Permeability of the Bone soil is very slow. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. Excess sodium or soluble salts occur throughout the profile.

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas are used for hay production.

The potential plant community on this unit is mainly inland saltgrass, western wheatgrass, Indian ricegrass, and Gardner saltbush. The Bone soil commonly does not support any significant amount of vegetation. As the range condition deteriorates, greasewood increases. As the range condition further deteriorates, annuals invade. The potential plant community produces about 500 pounds of air-dry vegetation in normal years. Production varies from 650 pounds in favorable years to 250 pounds in unfavorable years.

Some areas of this unit east of Wyoming Highway 59, immediately adjacent to the Cheyenne River, support different species and significantly higher levels of plant production than is typical for this unit. Alkali sacaton and western wheatgrass dominate these areas, and yields may range from 1,200 to 2,000 pounds of air-dry vegetation per year. These sites are on the lower parts of stream terraces and receive runoff from river tributaries.

The production of forage in most areas is limited by salinity or alkalinity and low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Range seeding is suitable if the range is in poor condition. The main limitations are salinity or alkalinity and lack of suitable adapted species for use in reclamation. The areas of this unit on the lower parts of stream terraces have fair suitability for seeding. These areas also can be improved by mechanical or chemical treatment if heavily infested with undesirable plants.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slow and very slow permeability, and slow runoff. Backfilling excavations with coarser textured material reduces the shrink-swell potential. Constructing a larger absorption

field or using selected material will help compensate for the slow and very slow permeability.

This map unit is in capability subclass VIs. Most of the unit is in the Saline Upland, 10- to 14-inch ppt., Northern Plains range site. The areas on the lower parts of stream terraces adjacent to the Cheyenne River are in Saline Lowland, 10- to 14-inch ppt., Northern Plains range site.

102—Aeric Haplaquepts, 0 to 3 percent slopes. These deep, poorly drained soils are in areas of centripetal drainage in playas. The soils formed in clayey local alluvium derived dominantly from sedimentary rock. Slopes are concave and are short or medium in length. Areas are generally oval in shape and are 1 to 100 acres in size. The native vegetation is mainly grasses.

Included in this unit are small areas of Silhouette clay loam, Savageton clay loam, and Bahl clay. Also included are small intermittent ponds. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

No single profile of Aeric Haplaquepts is typical, but one commonly observed in the survey area has a surface layer of light gray and light brownish gray clay loam about 8 inches thick. The underlying material to a depth of 48 inches or more is light gray and pale brown clay with yellow and yellowish red mottles. In some of the smaller areas of these soils, soft sedimentary bedrock is at a depth of 20 to 60 inches.

Permeability of the Aeric Haplaquepts is very slow. Available water capacity is high. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 0 and 12 inches for non-water-tolerant plants. Runoff is very slow, and the hazard of water erosion is slight. The hazard of wind erosion is slight. A seasonal high water table fluctuates between depths of 0 and 24 inches from March through July. Some areas of this unit are covered by water from snowmelt, intense rain showers, and runoff from adjacent areas.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly basin wildrye, green needlegrass, western wheatgrass, and Canada wildrye. As the range condition deteriorates, needleleaf sedge and Sandberg bluegrass increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 2,300 pounds of air-dry vegetation in normal years. Production varies from 2,800 pounds in favorable years to 1,900 pounds in unfavorable years. The types of vegetation in the larger playas also include those of wetland and subirrigated range sites in the lower positions and no vegetation in the lowest positions because of intermittent ponding.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds. Larger areas of this unit are used temporarily by migratory shore birds.

This unit is not suited to homesite development because of ponding.

This map unit is in capability subclass VIw. °Most of this unit is in the Clayey Overflow, 10- to 14-inch ppt., Northern Plains range site.

103—Bahl-Savageton complex, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on toe slopes and alluvial flats. Slopes are medium in length and are plane to slightly concave. The native vegetation is mainly grasses.

This unit is 40 percent Bahl clay and 35 percent Savageton clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ulm loam and Zigweid clay loam. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

The Bahl soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale olive clay about 4 inches thick. The underlying material to a depth of 60 inches or more is pale olive clay.

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

The Savageton soil is moderately deep and well drained. It formed in clayey local alluvium and residuum derived dominantly from calcareous shale. Typically, the surface layer is gray clay loam about 2 inches thick. The subsoil is light brownish gray and grayish brown clay about 30 inches thick. Platy shale is at a depth of 32 inches.

Permeability of the Savageton soil is very slow. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, green needlegrass, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cactus and broom

snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slow and very slow permeability, and the depth of the the Savageton soil to soft bedrock. Backfilling excavations with coarser textured material reduces the limitation of shrink-swell potential. Constructing a larger absorption field or using selected material helps to overcome the slow permeability of the Bahl soil. Areas of the Savageton soil are not suitable for use as septic tank absorption fields.

This map unit is in capability subclass IVe. It is in the Clayey, 10- to 14-inch ppt., Northern Plains range site.

104—Cambria-Cushman complex, 0 to 6 percent slopes. This map unit is on toe slopes and ridge crests of rolling uplands. Slopes are medium in length and are slightly convex to plane. The native vegetation is mainly grasses and shrubs.

This unit is 60 percent Cambria fine sandy loam and 30 percent Cushman loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ulm loam and Renohill sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from sedimentary rock. Typically, the surface layer is grayish brown fine sandy loam about 2 inches thick. The upper 8 inches of the subsoil is brown sandy clay loam, and the lower part to a depth of 60 inches or more is pale brown loam. In some areas soft bedrock is at a depth of 40 to 60 inches.

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

The Cushman soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale and sandstone. Typically, the surface layer is brown loam about 4 inches thick. The upper 11 inches of the subsoil is yellowish brown and light yellowish brown clay loam, and the lower 18 inches is pale brown clay loam and very pale brown sandy clay loam. Interbedded shale and sandstone are at a depth of 33 inches.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are moderate shrink-swell potential and the depth of the Cushman soil to soft bedrock. Backfilling excavations with coarser textured material reduces the limitation of shrink-swell potential. Areas of the Cushman soil are not suitable for use as septic tank absorption fields.

This map unit is in capability subclass IVe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

105—Cambria-Cushman complex, 6 to 15 percent slopes. This map unit is on back slopes of rolling uplands and on adjacent foot slopes. Slopes are short and are mostly convex. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Cambria sandy loam and 30 percent Cushman loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Renohill clay loam and Worf fine sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from sedimentary rock. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 4 inches of the subsoil is yellowish brown loam, and the lower part to a depth of 60 inches or more is pale brown loam. In some areas soft bedrock is between depths of 40 and 60 inches.

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

The Cushman soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale and sandstone. Typically, the surface layer is pale brown loam about 3 inches thick. The upper 14 inches of the subsoil is pale brown and light gray clay loam, and the lower 8 inches is pale yellow loam. Interbedded shale and sandstone are at a depth of 25 inches.

Permeability of the Cushman soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are moderate shrink-swell potential, slope, and the depth of the Cushman soil to soft bedrock. Backfilling with coarser textured material reduces the limitation of shrink-swell potential. Areas of the Cushman soil are not suitable for use as septic tank absorption fields.

This map unit is in capability subclass VIe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

106—Cambria Variant-Forkwood Variant complex, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on toe slopes and alluvial flats. Slopes are long and plane. The native vegetation is mainly grasses and shrubs.

This unit is 45 percent Cambria Variant fine sandy loam and 35 percent Forkwood Variant clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Hiland sandy loam and Ulm loam. Also included are small areas of soils that have a stratified substratum. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Cambria Variant soil is deep and well drained. It formed in loamy alluvium derived dominantly from interbedded sandstone and shale. Typically, the surface layer is light gray fine sandy loam about 2 inches thick. The upper 14 inches of the subsoil is light brownish gray clay loam and loam, and the lower 32 inches is light brownish gray stratified loam, clay loam, and sandy clay loam to a depth of 60 inches or more.

Permeability of the Cambria Variant soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Forkwood Variant soil is deep and well drained. It formed in loamy alluvium derived dominantly from interbedded sandstone and shale. Typically, the surface layer is light gray clay loam about 3 inches thick. The upper 13 inches of the subsoil is pale brown clay loam, and the lower part to a depth of 60 inches or more is light gray stratified loam, clay loam, and fine sandy loam.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitation is moderate shrink-swell potential. Backfilling excavations with coarser textured material helps to overcome this limitation.

This map unit is in capability subclass IVe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. There are inclusions of Clayey Overflow, 10- to 14-inch ppt., Northern Plains range site in areas where runoff water collects.

107—Clarkelen-Draknab complex, 0 to 3 percent slopes. This map unit is on flood plains. Slopes are long and plane. The native vegetation is mainly grasses and woody plants.

This unit is 50 percent Clarkelen sandy loam and 35 percent Draknab loamy sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Keeline sandy loam, Haverdad fine sandy loam, and Bigwin fine sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Clarkelen soil is deep and somewhat excessively drained. It formed in loamy recently deposited alluvium derived dominantly from sedimentary rock. Typically, the surface layer is pale brown and grayish brown sandy loam about 3 inches thick. The underlying material to a depth of 60 inches or more is highly stratified light brownish gray sand, sandy loam, sandy clay loam, and silt loam.

Permeability of the Clarkelen soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition occur along streambanks.

The Draknab soil is deep and excessively drained. It formed in sandy recently deposited alluvium derived dominantly from sandstone. Typically, the surface layer is yellowish brown loamy sand about 2 inches thick. The underlying material to a depth of 60 inches or more is pale brown and very pale brown, stratified sand, coarse sand, loamy sand, and loamy coarse sand.

Permeability of the Draknab soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition occur along streambanks.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, slender wheatgrass, needleandthread, and cottonwood trees. As the range condition deteriorates, silver sagebrush, rubber rabbitbrush, and snowberry increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 2,500 pounds of air-dry vegetation in normal years. Production varies from 3,000 pounds in favorable years to 2,000 pounds in unfavorable years.

The production of forage is limited by low annual precipitation and the hazard of flooding. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds. Cottonwood trees commonly provide important riparian habitat for birds and small mammals.

This unit is poorly suited to homesite development. The main limitations are the hazard of excavations caving in and the hazard of flooding. Constructing dikes reduces the risk of flooding. Use of septic tank

absorption fields could create a hazard of polluting ground water.

This map unit is in capability subclass IVe. It is in the Lowland, 10- to 14-inch ppt., Northern Plains range site.

108—Clarkelen-Dwyer-Orpha association, 0 to 10 percent slopes. This map unit is in gently sloping areas on flood plains and in undulating to gently rolling areas on dunes that are superimposed on stream terraces. The Clarkelen soil is on flood plains, and the Dwyer and Orpha soils are on terrace dunes. Slopes are medium in length and are plane, or they are short and convex. The native vegetation is mainly grasses and woody plants.

This unit is 40 percent Clarkelen sandy loam, 25 percent Dwyer loamy sand, and 20 percent Orpha loamy sand.

Included in this unit are small areas of Haverdad fine sandy loam, Draknab loamy sand, Keeline sandy loam, and Kishona loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Clarkelen soil is deep and somewhat excessively drained. It formed in loamy recently deposited alluvium derived dominantly from sedimentary rock. Typically, the surface layer is pale brown and grayish brown sandy loam about 3 inches thick. The underlying material to a depth of 60 inches or more is highly stratified, light brownish gray sand, sandy loam, sandy clay loam, and silt loam that contain carbonates.

Permeability of the Clarkelen soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is severe. The hazard of wind erosion is moderate. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

The Dwyer soil is deep and excessively drained. It formed in eolian sand derived from mixed sources. Typically, the surface layer is brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is pale brown loamy sand that contains carbonates within a depth of 40 inches.

Permeability of the Dwyer soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Orpha soil is deep and excessively drained. It formed in eolian sand derived from mixed sources. Typically, the surface layer is pale brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown loamy sand.

Permeability of the Orpha soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Clarkelen soil is mainly needleandthread, slender wheatgrass, western wheatgrass, and cottonwood trees. As the range condition deteriorates, silver sagebrush, rubber rabbitbrush, and snowberry increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 2,500 pounds of air-dry vegetation in normal years. Production varies from 3,000 pounds in favorable years to 2,000 pounds in unfavorable years.

The production of forage on the Clarkelen soil is limited by low annual precipitation and the hazard of flooding. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The suitability of this soil for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. This soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Dwyer and Orpha soils is mainly prairie sandreed, sand bluestem, needleandthread, and Indian ricegrass. As the range condition deteriorates, sageworts increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 2,000 pounds of air-dry vegetation in normal years. Production varies from 2,500 pounds in favorable years to 1,400 pounds in unfavorable years.

The production of forage on the Dwyer and Orpha soils is limited by droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The suitability of these soils for rangeland seeding is poor. The main limitations are the hazard of wind erosion and droughtiness. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds. Cottonwood trees commonly provide important riparian habitat for birds and small mammals.

The Clarkelen soil is poorly suited to homesite development. The main limitation is the hazard of flooding. Use of septic tank absorption fields could

create a hazard of polluting ground water. If the Dwyer and Orpha soils are used for homesite development, the main limitations are slope, the hazard of excavations caving in, and sand blowing.

The Clarkelen soil is in capability subclass IVe. The Dwyer and Orpha soils are in capability subclass VIe. The Clarkelen soil is in the Lowland, 10- to 14-inch ppt., Northern Plains range site. The Dwyer and Orpha soils are in the Sands, 10- to 14-inch ppt., Northern Plains range site.

109—Clarkelen-Haverdad-Bigwinder complex, 0 to 3 percent slopes. This map unit is on flood plains and low terraces of major streams. Slopes are medium in length and are plane. The native vegetation is mainly grasses, sedges, and woody plants.

This unit is 35 percent Clarkelen sandy loam, 25 percent Haverdad fine sandy loam, and 25 percent Bigwinder fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Draknab loamy sand, Keeline sandy loam, and Dwyer loamy sand. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Clarkelen soil is deep and somewhat excessively drained. It formed in loamy recently deposited alluvium derived dominantly from sedimentary rock. Typically, the surface layer is pale brown and grayish brown sandy loam about 3 inches thick. The underlying material to a depth of 60 inches or more is highly stratified, light brownish gray sand, sandy loam, sandy clay loam, and silt loam.

Permeability of the Clarkelen soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

The Haverdad soil is deep and well drained. It formed in loamy recently deposited alluvium derived dominantly from sedimentary rock. Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray loam with lenses of clay loam and fine sandy loam.

Permeability of the Haverdad soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition occur along streambanks.

The Bigwinder soil is deep and poorly drained. It formed in loamy alluvium derived dominantly from sedimentary rock. Typically, the surface layer is light brownish gray fine sandy loam about 3 inches thick. It has strong brown mottles. The upper 21 inches of the underlying material is stratified, light gray loam, sandy loam, and loamy sand, and the lower part to a depth of 60 inches or more is stratified, light gray and reddish yellow loamy sand and sand.

Permeability of the Bigwinder soil is moderate to moderately rapid to a depth of 24 inches and is rapid below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition occur along streambanks.

This unit is used mainly for livestock grazing and wildlife habitat. It is also used as hayland.

The potential plant community on the Clarkelen and Haverdad soils is mainly needleandthread, slender wheatgrass, green needlegrass, and cottonwood trees (fig. 2). As the range condition deteriorates, silver sagebrush, rubber rabbitbrush, and snowberry increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 2,500 pounds of air-dry vegetation in normal years. Production varies from 3,000 pounds in favorable years to 2,000 pounds in unfavorable years.

The production of forage on these soils is limited by low annual precipitation and the hazard of flooding. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase.

The potential plant community on the Bigwinder soil is mainly Nebraska sedge, basin wildrye, slender wheatgrass, and willows. As the range condition deteriorates, western wheatgrass, mat muhly, and spike sedge increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 4,000 pounds of air-dry vegetation in normal years. Production varies from 4,500 pounds in favorable years to 3,500 pounds in unfavorable years.

The production of forage on this soil is limited by wetness and the hazard of flooding. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Figure 2.—Area of Clarkelen-Haverdad-Bigwinder complex, 0 to 3 percent slope, along Box Creek. This area supports scattered cottonwood trees.

The suitability of this soil for rangeland seeding is good. The main limitations are wetness and the hazard of flooding.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds. Cottonwood trees commonly provide important riparian habitat for birds and small mammals.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and wetness. Construction of dikes reduces the risk of flooding. Use of septic tank absorption fields could create a hazard of polluting ground water.

This map unit is in capability subclass IVe. The Clarkelen and Haverdad soils are in the Lowland, 10- to 14-inch ppt., Northern Plains range site. The Bigwinder soil is in the Subirrigated, 10- to 14-inch ppt., Northern Plains range site.

110—Cushman-Terro complex, 0 to 6 percent slopes. This map unit is on pediment slopes of nearly level to undulating dissected uplands. Slopes are medium in length and are convex. The native vegetation is mainly grasses and shrubs.

This unit is 45 percent Cushman loam and 40 percent Terro sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Shingle clay loam in the more highly dissected areas. Also included are small areas of Hiland sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Cushman soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale and sandstone. Typically, the surface layer is brown loam about 4 inches thick. The upper 11 inches of the subsoil is yellowish brown and light yellowish brown clay loam, and the lower 18 inches

is pale brown clay loam and very pale brown loam. Interbedded sandstone and shale are at a depth of 33 inches.

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

The Terro soil is moderately deep and somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 19 inches of the subsoil is brown and pale brown sandy loam, and the lower 11 inches is light gray sandy loam. Soft sandstone is at a depth of 34 inches. In some areas soft bedrock is at a depth of 40 to 60 inches or more.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Cushman soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The potential plant community on the Terro soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. The main limitation is the hazard of wind erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are depth to soft bedrock and shrink-swell potential. Backfilling excavations with coarser textured material helps to overcome the problem of shrink-swell potential. It may be necessary to construct a mounded absorption field to compensate for the restricted depth to bedrock.

This map unit is in capability subclass IVe. The Cushman soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Terro soil is in the Sandy, 10- to 14-inch ppt., Northern Plains range site.

111—Cushman-Terro complex, 6 to 15 percent slopes. This map unit is on shoulder slopes and back slopes of rolling uplands. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 55 percent Cushman loam and 30 percent Terro sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Shingle clay loam and Worf fine sandy loam on shoulder slopes. Also included are small areas of Hiland sandy loam on back slopes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Cushman soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale and sandstone. Typically, the surface layer is pale brown loam about 3 inches thick. The upper 14 inches of the subsoil is pale brown and light gray clay loam, and the lower 8 inches is pale yellow loam. Interbedded sandstone and shale are at a depth of 25 inches. In some areas soft bedrock is at a depth of 40 to 60 inches or more.

Permeability of the Cushman soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

The Terro soil is somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 19 inches of the subsoil is brown and pale brown sandy loam, and the lower 11 inches is light gray sandy loam. Soft sandstone is at a depth of 34 inches. In some areas soft bedrock is at a depth of 40 to 60 inches or more.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water

erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Cushman soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The potential plant community on the Terro soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitations are the hazards of wind and water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are depth to soft bedrock, slope, and the moderate shrink-swell potential of the Cushman soil, which can be overcome by backfilling with coarser textured material. It may be necessary to construct a mounded absorption field to compensate for the limited depth to bedrock.

This map unit is in capability subclass VIe. The Cushman soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Terro soil is in the Sandy, 10- to 14-inch ppt., Northern Plains range site.

112—Cushman-Worf association, 6 to 15 percent slopes. This map unit is on ridges, shoulder slopes, and back slopes of rolling uplands. Slopes are convex and are medium in length. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Cushman loam, 6 to 10 percent slopes, and 35 percent Worf fine sandy loam, 10 to 15 percent slopes. The Cushman soil is on back slopes, and the Worf soil is on ridges and shoulder slopes.

Included in this unit are small areas of Worfka fine sandy loam and Shingle loam intermingled with areas of the Worf soil. Also included are small areas of Forkwood sandy loam on concave slopes bordering areas of the Cushman soil. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Cushman soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from interbedded sandstone and shale. Typically, the surface layer is pale brown loam about 3 inches thick. The upper 14 inches of the subsoil is pale brown and light gray clay loam, and the lower 8 inches is pale yellow loam. Interbedded shale and sandstone are at a depth of 25 inches.

Permeability of the Cushman soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

The Worf soil is shallow and well drained. It formed in residuum derived dominantly from calcareous shale. Typically, the surface layer is grayish brown fine sandy loam about 2 inches thick. The subsoil is brown and light yellowish brown sandy clay loam about 16 inches thick. Soft, calcareous shale is at a depth of 18 inches.

Permeability of the Worf soil is moderate. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Cushman soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years. The production of forage is limited by low annual precipitation. The suitability of this soil for rangeland seeding is good.

The potential plant community on the Worf soil is mainly western wheatgrass, green needlegrass, and bluebunch wheatgrass. As the range condition deteriorates, birdfoot sagebrush and big sagebrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200

pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on this unit is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are the limited rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are slope, depth to soft bedrock, and moderate shrink-swell potential. Backfilling excavations with coarser textured material helps to overcome the limitation of moderate shrink-swell potential. Construction of a mounded absorption field may be needed to compensate for the depth to rock.

This map unit is in capability subclass VIe. The Cushman soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Worf soil is in the Shallow Clayey, 10- to 14-inch ppt., Northern Plains range site.

113—Dwyer-Orpha loamy sands, 3 to 15 percent slopes. This map unit is on undulating to rolling dunes superimposed on stream terraces and alluvial flats. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Dwyer loamy sand and 30 percent Orpha loamy sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Keeline sandy loam, Vonalee loamy sand, and Hiland sandy loam in swales and other depressional areas. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Dwyer soil is deep and excessively drained. It formed in sandy eolian material derived from mixed sources. Typically, the surface layer is brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is pale brown loamy sand. Carbonates are within 40 inches of the surface. In some areas buried loamy strata are at a depth of 40 inches or more. In a few areas calcareous sandstone is at a depth of 20 to 60 inches.

Permeability of the Dwyer soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Orpha soil is deep and excessively drained. It formed in sandy eolian material derived from mixed sources. Typically, the surface layer is grayish brown loamy sand about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray sand. Carbonates are below a depth of 40 inches. In some areas buried loamy strata are at a depth of 40 inches or more.

Permeability of the Orpha soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly prairie sandreed, Indian ricegrass, needleandthread, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. If the vegetation further deteriorates, annuals and snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitations are the hazards of erosion by wind and water. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are the hazard of excavations caving in, slope, and sand blowing.

This map unit is in capability subclass VIIe. It is in the Sandy, 10- to 14-inch ppt., Northern Plains range site. In some of the steeper areas are inclusions of Sands, 10- to 14-inch ppt., Northern Plains range site.

114—Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas of foot slopes and toe slopes of rolling

uplands. Slopes are long and plane. The native vegetation is mainly grasses and shrubs.

This unit is 55 percent Forkwood fine sandy loam and 30 percent Cambria fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ulm loam and Zigweid clay loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Forkwood soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale brown fine sandy loam about 7 inches thick. The upper 7 inches of the subsoil is pale brown clay loam, and the lower part to a depth of 60 inches or more is light brownish gray and light gray clay loam. In some areas bedrock is at a depth of 20 to 60 inches.

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

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from sedimentary rock. Typically, the surface layer is grayish brown fine sandy loam about 2 inches thick. The upper 8 inches of the subsoil is brown sandy clay loam, and the lower part to a depth of 60 inches or more is pale brown loam.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is well suited to homesite development. It has few limitations. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Septic tank absorption fields operate most effectively if placed deep in the subsoil.

This map unit is in capability subclass IVe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

115—Forkwood-Cambria-Cushman complex, 6 to 15 percent slopes. This map unit is on ridge crests, back slopes, and foot slopes of rolling uplands. Slopes are short and are mostly convex. The native vegetation is mainly grasses and shrubs.

This unit is 30 percent Forkwood fine sandy loam, 30 percent Cambria sandy loam, and 30 percent Cushman loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ulm loam and Worf fine sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Forkwood soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale brown fine sandy loam about 5 inches thick. The upper 13 inches of the subsoil is light yellowish brown clay loam, and the lower part to a depth of 60 inches or more is pale yellow and light gray loam.

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

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from sedimentary rock. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 4 inches of the subsoil is yellowish brown loam, and the lower part to a depth of 60 inches or more is pale brown loam.

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

The Cushman soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown loam about 3 inches thick. The upper 14 inches of the subsoil is pale brown and light gray clay loam, and the lower 8 inches is pale yellow loam over

interbedded shale and sandstone. Soft bedrock is at a depth of 25 inches.

Permeability of the Cushman soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are moderate shrink-swell potential and the depth of the Cushman soil to soft bedrock. Backfilling excavations with coarser textured material helps to overcome the limitation of moderate shrink-swell potential. Septic tank absorption fields operate most effectively if placed deep in the subsoil of the Cambria and Forkwood soils; areas of the Cushman soil are not suitable for this use.

This map unit is in capability subclass VIe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

116—Forkwood-Ulm complex, 0 to 6 percent slopes. This map unit is on foot slopes and toe slopes. Slopes are plane and are medium to long. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Forkwood fine sandy loam and 40 percent Ulm loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bidman sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Forkwood soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale brown fine sandy loam about 7 inches thick. The upper 7 inches of the subsoil is pale brown clay loam, and the lower part to a depth of 60 inches or more is light brownish gray and light gray clay loam. In some areas the subsoil is sandy clay loam.

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

The Ulm soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is brown loam about 5 inches thick. The upper 16 inches of the subsoil is brown clay loam and clay, and the lower part to a depth of 60 inches or more is pale brown clay loam and light yellowish brown sandy clay loam.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are high shrink-swell potential and the slow permeability of the Ulm soil. Backfilling excavations with coarser textured material helps to overcome the

limitation of shrink-swell potential. Constructing a larger septic tank absorption field helps to compensate for the slow permeability of the Ulm soil. Absorption lines operate most effectively if they are placed deep in the subsoil.

This map unit is in capability subclass IVe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

117—Forkwood-Ulm-Renohill complex, 6 to 15 percent slopes. This map unit is on foot slopes, back slopes, and ridges of rolling uplands. Slopes are short and are convex to plane. The native vegetation is mainly grasses and shrubs.

This unit is 35 percent Forkwood fine sandy loam, 30 percent Ulm clay loam, and 20 percent Renohill clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Cushman loam, Bidman sandy loam, and Worfka fine sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Forkwood soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale brown fine sandy loam about 7 inches thick. The upper 7 inches of the subsoil is pale brown clay loam, and the lower part to a depth of 60 inches or more is light brownish gray and light gray clay loam.

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

The Ulm soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The upper 12 inches of the subsoil is brown clay loam, and the lower part to a depth of 60 inches or more is light gray clay loam.

Permeability of the Ulm soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Renohill soil is moderately deep and well drained. It formed in clayey residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 5 inches thick. The subsoil is light brownish gray clay loam about 20 inches thick. Calcareous gritty shale is at a depth of 25 inches.

Permeability of the Renohill soil is slow. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Forkwood soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The potential plant community on the Ulm and Renohill soils is mainly western wheatgrass, thickspike wheatgrass, and green needlegrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slope, slow permeability of the Ulm and Renohill soils, and the depth of the Renohill soil to soft bedrock. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Constructing a larger absorption field helps to compensate for the slow permeability of the Ulm and Renohill soils. Absorption fields are most effective if they are placed deep in the subsoil of the Forkwood soil; the Renohill soil is not suitable for use as absorption fields.

This map unit is in capability subclass VIe. The Forkwood soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Ulm and Renohill soils are in the Clayey, 10- to 14-inch ppt., Northern Plains range site.

118—Gateson Variant-Tassel Variant association, 10 to 45 percent slopes. This map unit is on upland

ridges, shoulder slopes, and back slopes on the northern end of Pine Ridge. Slopes are convex and are medium in length. The native vegetation in the steeper areas is mainly conifers with an understory of grasses, and in the less sloping areas it is mainly grasses with scattered conifers. Sandstone and ironstone channery fragments and flagstones cover as much as 50 percent of the surface in some areas.

This unit is 45 percent Gateson Variant loamy sand and 35 percent Tassel Variant very fine sandy loam. The Gateson Variant soil is on steep back slopes, and the Tassel Variant soil is on ridges.

Included in this unit are small areas of Worf fine sandy loam, Tullock loamy sand, and Terro loamy fine sand. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Gateson Variant soil is shallow and well drained. It formed in loamy residuum derived dominantly from noncalcareous sandstone. Typically, the surface is covered with a mat of pine needles and other forest litter about 2 inches thick. The surface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is reddish yellow sandy clay loam about 7 inches thick. The substratum is pinkish gray clay about 5 inches thick over soft, noncalcareous, interbedded sandstone and shale. Soft bedrock is at a depth of 15 to 24 inches.

Permeability of the Gateson Variant soil is moderate. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Tassel Variant soil is very shallow and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is light yellowish brown very fine sandy loam about 4 inches thick. The underlying material to a depth of 9 inches is gray loam. Soft, calcareous sandstone is at a depth of 9 inches.

Permeability of the Tassel Variant soil is moderate. Available water capacity is very low. Effective rooting depth is 5 to 10 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas are used as a source of wood products.

The Gateson Variant soil is poorly suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 35 to 50. This soil can produce 12 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The main concerns in producing and harvesting timber are shallow soil depth, slow regeneration of trees, the hazard of erosion, and difficulty of harvesting on the steeper slopes. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. The very low available water capacity generally influences seedling survival in areas where understory plants are numerous. Conventional methods of harvesting timber are difficult to use because of slope.

The potential understory plant community on the Gateson Variant soil is mainly Idaho fescue and yarrow. The woodland understory produces about 650 pounds of air-dry vegetation in normal years. Production varies from 800 pounds in favorable years to 400 pounds in unfavorable years.

The potential plant community on the Tassel Variant soil is mainly needleandthread, prairie sandreed, little bluestem, and bluebunch wheatgrass. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,600 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on this soil is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Tassel Variant soil for rangeland seeding is poor. The main limitations are limited rooting depth and the hazards of erosion by wind and water. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are slope, shrink-swell potential, and depth to soft bedrock. Backfilling excavations with coarser textured material reduces the limitation of shrink-swell potential. Absorption fields should be constructed of selected material.

This map unit is in capability subclass VIIe. The Gateson Variant soil is not placed in a range site. The Tassel Variant soil is in the Shallow Sandy, 15- to 17-inch ppt., Northern Plains range site.

119—Gullied land. This map unit is in rolling to steep areas where gullies have downcut into friable soil material. The remaining soil material is shallow to deep and is well drained. It was derived from sedimentary residuum and local alluvium. Slopes are short and convex. This unit is essentially barren.

Typically, the original surface layer and subsoil have been lost through erosion. The remaining soil material is

10 to 60 inches thick or more over bedrock. Texture ranges from sandy loam to clay loam.

Included in this unit are small areas of Shingle clay loam, Theedle loam, Samday clay loam, and Savageton clay loam. Also included are small areas of exposed sandstone and shale. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of the soil material in this unit is slow to moderate. Available water capacity is low to moderate. Effective rooting depth is 10 to 60 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

This unit is used mainly for wildlife habitat. The included areas are also used for livestock grazing.

The vegetation on the included areas in this unit provides some food for antelope, deer, small mammals, and birds.

This map unit is in capability subclass VIIIe. It is not placed in a range site.

120—Haverdad-Lohmiller complex, 0 to 6 percent slopes. This map unit is on flood plains. Slopes are short and plane. The native vegetation is mainly grasses, woody shrubs, and scattered cottonwood trees. This unit is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

This unit is 50 percent Haverdad fine sandy loam and 30 percent Lohmiller clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Draknab loamy sand on flood plains and small areas of Kishona loam and Bahl clay on alluvial flat remnants. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Haverdad soil is deep and well drained. It formed in loamy recently deposited alluvium derived dominantly from sedimentary rock. Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray loam with lenses of clay loam and fine sandy loam.

Permeability of the Haverdad soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A slight accumulation of soluble salts is in the surface layer and the upper part of the subsoil in some areas.

The Lohmiller soil is deep and well drained. It formed in stratified, clayey, recently deposited alluvium derived dominantly from shale. Typically, the surface layer is grayish brown clay loam about 3 inches thick. The next layer is brown clay 13 inches thick. Below this to a depth of 60 inches or more is stratified, light yellowish brown and brown sandy clay loam, sandy loam, and sandy clay.

Permeability of the Lohmiller soil is slow to moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly green needlegrass, slender wheatgrass, needleandthread, and cottonwood trees. As the range condition deteriorates, woody plants such as snowberry, silver sagebrush, and rubber rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 2,500 pounds of air-dry vegetation in normal years. Production varies from 3,000 pounds in favorable years to 2,000 pounds in unfavorable years.

The production of forage is limited by low annual precipitation and the hazard of flooding. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds. Cottonwood trees commonly provide important riparian habitat for birds and small mammals.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and shrink-swell potential. Construction of dikes reduces the risk of flooding. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential.

This map unit is in capability subclass IVw. It is in the Lowland, 10- to 14-inch ppt., Northern Plains range site. In some areas are inclusions of Clayey Overflow, 10- to 14-inch ppt., Northern Plains range site.

121—Hiland-Bowbac sandy loams, 0 to 6 percent slopes. This map unit is on foot slopes and pediment slopes. Slopes are convex and are medium in length. The native vegetation is mainly grasses and shrubs.

This unit is 70 percent Hiland sandy loam and 20 percent Bowbac sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ulm loam, Vonalee loamy sand, and Terro sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Hiland soil is deep and well drained. It formed in loamy residuum, local alluvium, and eolian material derived dominantly from calcareous sandstone. Typically, the surface layer is pale brown sandy loam about 5 inches thick. The upper 25 inches of the subsoil is pale brown and light yellowish brown sandy clay loam, and the lower part to a depth of 60 inches or more is very pale brown sandy loam. In some areas the subsoil is loam or light clay loam.

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

The Bowbac soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 3 inches thick. The upper 15 inches of the subsoil is brown sandy clay loam, and the lower 18 inches is brown and light yellowish brown sandy loam. Soft, calcareous sandstone is at a depth of 36 inches. In some areas the subsoil is loam or light clay loam.

Permeability of the Bowbac soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas where water is available from small reservoirs are used for irrigated alfalfa.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Alfalfa yields average about 2.0 to 2.5 tons per acre with a moderate level of management.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitation is depth to soft bedrock in the Bowbac soil. Areas of Hiland soil should be selected for absorption fields.

This map unit is in capability subclass IVe, irrigated and nonirrigated. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

122—Hiland-Bowbac complex, 6 to 15 percent slopes. This map unit is on ridges and back slopes of rolling uplands. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 60 percent Hiland sandy clay loam and 30 percent Bowbac sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Vonalee loamy sand, Renohill clay loam, Terro sandy loam, and Worf fine sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Hiland soil is deep and well drained. It formed in loamy residuum and eolian material derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy clay loam about 3 inches thick. The upper 21 inches of the subsoil is brown sandy loam and sandy clay loam, and the lower part to a depth of 60 inches or more is grayish brown and light brownish gray sandy loam and sandy clay loam. In some areas the subsoil is loam or light clay loam.

Permeability of the Hiland soil is moderate to moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Bowbac soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 11 inches of the subsoil is brown and dark yellowish brown sandy clay loam, and the lower 13 inches is light yellowish brown fine sandy loam. Soft calcareous sandstone is at a depth of 28 inches. In some areas the subsoil is loam or light clay loam.

Permeability of the Bowbac soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and

needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are slope and the depth of the Bowbac soil to soft bedrock. Areas of the Bowbac soil are not suitable for absorption fields.

This map unit is in capability subclass VIe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

123—Keeline-Tassel-Turnback complex, 6 to 15 percent slopes. This map unit is on rolling uplands. Slopes are short to medium in length and are mostly convex. The native vegetation is mainly grasses.

This unit is 35 percent Keeline sandy loam, 25 percent Tassel loamy fine sand, and 20 percent Turnback loamy fine sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Tullock loamy sand, Orpha loamy sand, and Dwyer loamy sand on ridge crests and on lee slopes where windblown sand collects. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Keeline soil is deep and somewhat excessively drained. It formed in loamy, wind-worked residuum derived dominantly from calcareous sandstone. Typically, the surface layer is yellowish brown sandy loam about 3 inches thick. The subsoil is pale brown sandy loam about 5 inches thick. The underlying material to a depth of 60 inches or more is very pale brown sandy loam.

Permeability of the Keeline soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

The Tassel soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is light brownish gray loamy fine sand 2 inches thick. The underlying material to a depth of 16 inches is pale brown fine sandy loam. Soft sandstone is at a depth of 16 inches.

Permeability of the Tassel soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Turnback soil is moderately deep and well drained. It formed in loamy, wind-worked residuum derived dominantly from calcareous sandstone. Typically, the surface layer is pale brown loamy fine sand about 4 inches thick. The subsoil is light yellowish brown and pale yellow sandy loam about 26 inches thick. Soft sandstone is at a depth of 30 inches.

Permeability of the Turnback soil is moderately rapid. Available water capacity is very low to low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Keeline and Turnback soils is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is fair. The main limitation is the hazard of wind erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Tassel soil is mainly needleandthread, prairie sandreed, Indian

ricegrass, and little bluestem. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,000 pounds of air-dry vegetation in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The production of forage on this soil is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this soil for rangeland seeding is poor. The main limitations are limited rooting depth and the hazards of wind and water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If the Keeline soil is used for homesite development, the main limitation is slope. The Tassel and Turnback soils are limited by depth to soft bedrock. They are not suitable for absorption fields.

This map unit is in capability subclass VIe. The Keeline and Turnback soils are in the Sandy, 10- to 14-inch ppt., Northern Plains range site. The Tassel soil is in the Shallow Sandy, 10- to 14-inch ppt., Northern Plains range site.

124—Kishona-Dwyer-Orpha association, 0 to 10 percent slopes. This map unit is on nearly level to undulating alluvial flats and gently rolling dunes superimposed on stream terraces. Slopes are long and plane or short and convex. The Kishona soils are on alluvial flats, and the Dwyer and Orpha soils are on terrace dunes. The native vegetation is mainly grasses.

This unit is 35 percent Kishona loam, 25 percent Dwyer loamy sand, and 15 percent Orpha loamy sand.

Included in this unit are small areas of Draknab loamy sand and Haverdad fine sandy loam on flood plains and Bahl clay on alluvial flats. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

The Kishona soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is brown loam about 3 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and light gray clay loam. Carbonates are disseminated throughout the soil.

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

The Dwyer soil is deep and excessively drained. It formed in eolian sand derived dominantly from mixed sources. Typically, the surface layer is brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is pale brown loamy sand. Carbonates are at a depth of less than 40 inches.

Permeability of the Dwyer soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Orpha soil is deep and excessively drained. It formed in eolian sand derived from mixed sources. Typically, the surface layer is pale brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown loamy sand. Depth to carbonates is less than 40 inches.

Permeability of the Orpha soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Kishona soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on the Kishona soil is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this soil for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The potential plant community on the Dwyer and Orpha soils is mainly prairie sandreed, sand bluestem, needleandthread, and Indian ricegrass. As the range condition deteriorates, sageworts increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 2,000 pounds of air-dry vegetation in

normal years. Production varies from 2,500 pounds in favorable years to 1,400 pounds in unfavorable years.

The production of forage is limited by droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is poor. The main limitations are the hazard of wind erosion and droughtiness. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If the Kishona soil is used for homesite development, the main limitation is moderate shrink-swell potential. If the Dwyer and Orpha soils are used for homesite development, the main limitations are the hazard of cutbanks caving in, sand blowing, and slope. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential in the Kishona soil.

The Kishona soil is in capability subclass IVe, and the Dwyer and Orpha soils are in capability subclass VIe. The Kishona soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Dwyer and Orpha soils are in the Sands, 10- to 14-inch ppt., Northern Plains range site.

125—Orella-Rock outcrop-Samday complex, 3 to 30 percent slopes. This map unit is on ridgetops, shoulders, and back slopes of undulating to steep uplands. Slopes are medium in length and are convex. The native vegetation is mainly grasses and forbs.

This unit is 35 percent Orella clay loam, 25 percent Rock outcrop, and 25 percent Samday clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Shingle clay loam, Tassel sandy loam, and Theedle loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Orella soil is shallow and well drained. It formed in clayey residuum derived dominantly from sodic shale. The surface layer is light gray clay loam about 4 inches thick. The underlying material to a depth of 20 inches is light gray and light brownish gray clay. Fragmented shale is at a depth of 20 inches.

Permeability of the Orella soil is very slow. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Rock outcrop is exposures of multicolored, calcareous and noncalcareous, soft and moderately hard shale and siltstone.

The Samday soil is shallow and well drained. It formed in clayey residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 2 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay. Soft shale is at a depth of 18 inches.

Permeability of the Samday soil is slow. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, green needlegrass, and bluebunch wheatgrass. As the range condition deteriorates, birdfoot sagebrush and big sagebrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are limited rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slope, and depth to shale. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential.

This map unit is in capability subclass VIIe. The Orella and Samday soils are in the Shallow Clayey, 10- to 14-inch ppt., Northern Plains range site.

126—Pits, mine. This map unit consists of open pits and spoil material from small- and moderate-sized uranium operations. None of these areas are currently being mined, and reclamation plans have not been developed. These areas support little if any vegetation.

Open pits are vertical or very steep excavations into sedimentary rock consisting of rippable sandstone with some interbedded shale and coal seams. Physical and chemical properties of the pit wall and displaced spoil banks are highly variable. The spoil material is mixed, and it is extremely acid to moderately alkaline. The material commonly is sandy, but some layers are loamy and clayey.

Onsite investigation of individual areas is necessary to determine reclamation potential. Backfilling excavations and reshaping cut slopes reduce the risk of erosion. Backfilling with suitable topsoil aids revegetation.

127—Renohill-Worfka-Shingle complex, 0 to 6 percent slopes. This map unit is on upland summits and back slopes. Slopes are medium in length and are convex. The native vegetation is mainly grasses and shrubs.

This unit is 35 percent Renohill fine sandy loam, 30 percent Worfka fine sandy loam, and 20 percent Shingle clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Samday clay loam, Worf fine sandy loam, and Bidman sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Renohill soil is moderately deep and well drained. It formed in clayey residuum derived dominantly from soft shale. Typically, the surface layer is pale brown fine sandy loam about 5 inches thick. The upper 15 inches of the subsoil is brown clay, and the lower 16 inches is pale brown clay loam. Calcareous shale is at a depth of 36 inches. In some areas depth to soft bedrock ranges from 40 to 60 inches or more.

Permeability of the Renohill soil is slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Worfka soil is shallow and well drained. It formed in clayey residuum derived dominantly from calcareous shale and sandstone. Typically, the surface layer is pale brown fine sandy loam about 6 inches thick. The upper 6 inches of the subsoil is light brownish gray clay, and the lower 6 inches is light yellowish brown clay loam. Soft interbedded shale and sandstone are at a depth of 18 inches.

Permeability of the Worfka soil is slow. Available water capacity is very low to low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay loam. Soft shale is at a depth of 18 inches.

Permeability of the Shingle soil is moderate. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This unit is used for livestock grazing, nonirrigated crops, and wildlife habitat.

The potential plant community on the Renohill soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and brown snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on the Renohill soil is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this soil for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The potential plant community on the Worfka and Shingle soils is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is poor. The main limitations are limited rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

A few small, nearly level areas of this unit have a higher percentage of Renohill soil than is typical; these areas are used for nonirrigated wheat. Yield averages about 15 to 20 bushels per acre every other year with a moderate level of management. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable. Crop residue left on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential and depth to soft bedrock. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential.

This map unit is in capability subclass VIe. The Renohill soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Worfka and Shingle soils are in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site.

128—Renohill-Worfka-Shingle complex, 6 to 15 percent slopes. This map unit is on back slopes of rolling uplands. Slopes are short to medium in length and are convex. The native vegetation is mainly grasses and shrubs.

This unit is 35 percent Renohill clay loam, 30 percent Worfka fine sandy loam, and 20 percent Shingle clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Samday clay loam, Worf fine sandy loam, and Cushman loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Renohill soil is moderately deep and well drained. It formed in clayey residuum derived dominantly from soft shale. Typically, the surface layer is light brownish gray clay loam about 5 inches thick. The subsoil is light brownish gray clay loam 20 inches thick. Calcareous, gritty shale is at a depth of 25 inches. In some areas soft bedrock is at a depth of 40 to 60 inches or more.

Permeability of the Renohill soil is slow. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Worfka soil is shallow and well drained. It formed in clayey residuum derived dominantly from calcareous shale and sandstone. Typically, the surface layer is grayish brown fine sandy loam about 3 inches thick. The upper 5 inches of the subsoil is pale brown clay, and the lower 6 inches is light yellowish brown clay loam. Interbedded shale and sandstone are at a depth of 14 inches.

Permeability of the Worfka soil is slow. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay loam. Soft shale is at a depth of 18 inches.

Permeability of the Shingle soil is moderate. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Renohill soil is mainly western wheatgrass, green needlegrass, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti and broom snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The production of forage on the Renohill soil is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this soil for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The potential plant community on the Worfka soil is mainly western wheatgrass, green needlegrass, and bluebunch wheatgrass. As the range condition deteriorates, birdfoot sagebrush and big sagebrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The potential plant community on the Shingle soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant

community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on the Worfka and Shingle soils is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is poor. The main limitations are limited rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slope, and depth to soft bedrock. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential.

This map unit is in capability subclass VIIe. The Renohill soil is in the Clayey, 10- to 14-inch ppt., Northern Plains range site. The Worfka soil is in the Shallow Clayey, 10- to 14-inch ppt., Northern Plains range site. The Shingle soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site.

129—Samday-Shingle-Worf complex, 3 to 15 percent slopes. This map unit is on summits and ridges of undulating to rolling uplands. Slopes are short and convex. The native vegetation is mainly grasses and forbs.

This unit is 30 percent Samday clay loam, 25 percent Shingle clay loam, and 25 percent Worf fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Worfka fine sandy loam, Renohill clay loam, and Theedle loam. Also included are small areas of Rock outcrop. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Samday soil is shallow and well drained. It formed in clayey residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 2 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay. Soft shale is at a depth of 18 inches.

Permeability of the Samday soil is slow. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay loam. Soft shale is at a depth of 18 inches.

Permeability of the Shingle soil is moderate. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Worf soil is shallow and well drained. It formed in loamy residuum derived dominantly from interbedded shale and sandstone. Typically, the surface layer is grayish brown fine sandy loam about 2 inches thick. The subsoil is brown and light yellowish brown sandy clay loam about 16 inches thick. Soft shale is at a depth of 18 inches.

Permeability of the Worf soil is moderate. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Samday and Worf soils is mainly western wheatgrass, green needlegrass, and bluebunch wheatgrass. As the range condition deteriorates, birdfoot sagebrush and big sagebrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The potential plant community on the Shingle soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on this unit is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are limited rooting depth and the hazard of water erosion. Areas that are heavily

infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slope, and depth to shale. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Absorption fields should be constructed using selected material.

This map unit is in capability subclass VIIe. The Samday and Worf soils are in the Shallow Clayey, 10- to 14-inch ppt., Northern Plains range site. The Shingle soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site.

130—Sear-Wibaux complex, 0 to 15 percent slopes. This map unit is in nearly level areas on the summit of buttes and in undulating to rolling areas on shale uplands. Slopes are short and are plane to convex. The native vegetation is mainly grasses and forbs.

This unit is 45 percent Sear loam and 35 percent Wibaux channery loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Shingle loam, Samday clay loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Sear soil is very shallow and well drained. It formed in channery loamy residuum derived dominantly from fragmented porcellanite. Typically, the surface layer is pinkish gray loam about 2 inches thick. The subsoil is brown channery loam about 7 inches thick. Fragmented porcellanite with soil material partially filling voids in it is between depths of 9 and 60 inches or more.

Permeability of the Sear soil is moderate to a depth of 9 inches and very rapid below this depth. Available water capacity is low. Effective rooting depth is 5 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

The Wibaux soil is shallow and somewhat excessively drained. It formed in channery loamy residuum derived dominantly from fragmented porcellanite. Typically, the surface layer is pinkish gray channery loam about 4 inches thick. The underlying material to a depth of 11 inches is light brown very channery loam. Fragmented porcellanite with soil material partially filling voids in it is between depths of 11 and 60 inches or more.

Permeability of the Wibaux soil is moderate to a depth of 11 inches and very rapid below this depth. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Sear soil is mainly bluebunch wheatgrass, little bluestem, western wheatgrass, and needleandthread. As the range condition deteriorates, woody plants increase. As the range condition further deteriorates, annuals invade. The potential plant community produces about 600 pounds of air-dry vegetation in normal years. Production varies from 600 pounds in favorable years to 400 pounds in unfavorable years.

The potential plant community on the Wibaux soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on this unit is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are limited rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitation is depth to porcellanite fragments or soft bedrock. Absorption fields should be constructed using selected material.

This map unit is in capability subclass VIIe. The Sear soil is in the Very Shallow, 10- to 14-inch ppt., Northern Plains range site. The Wibaux soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site.

131—Shingle-Rock outcrop-Samday complex, 10 to 30 percent slopes. This map unit is on ridgetops, shoulders, and back slopes of rolling to steep uplands and on actively eroding escarpments. Slopes are medium in length and are convex. The native vegetation is mainly grasses and forbs.

This unit is 40 percent Shingle clay loam, 25 percent Rock outcrop, and 20 percent Samday clay loam. The components of this unit are so intricately intermingled

that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Theedle loam and Tassel sandy loam. Also included are small areas of Shingle, thin solum, soils and Tassel, thin solum, soils that formed in neutral, interbedded shale and sandstone. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown clay loam about 4 inches thick. The underlying material to a depth of 13 inches is light brownish gray clay loam. Interbedded shale and sandstone are at a depth of 13 inches.

Permeability of the Shingle soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

Rock outcrop is exposures of multicolored, calcareous and noncalcareous, soft to moderately hard shale and siltstone.

The Samday soil is shallow and well drained. It formed in clayey residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 2 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay. Interbedded shale and sandstone are at a depth of 18 inches.

Permeability of the Samday soil is slow. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Shingle soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The potential plant community on the Samday soil is mainly western wheatgrass, green needlegrass, and bluebunch wheatgrass. As the range condition deteriorates, birdfoot sagebrush and big sagebrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on these soils is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The suitability of these soils for rangeland seeding is poor. The main limitations are limited rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. The soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential, slope, and depth to soft bedrock. Backfilling excavations with coarser textured material reduces the shrink-swell potential. Absorption fields should be constructed using selected material.

This map unit is in capability subclass VIIe. The Shingle soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site. The Samday soil is in the Shallow Clayey, 10- to 14-inch ppt., Northern Plains range site. The included Tassel, thin solum, soil is a woodland soil.

132—Shingle, thin solum-Rock outcrop-Tassel, thin solum complex, cool, 6 to 45 percent slopes. This map unit is in rolling to steep areas on upland ridges, escarpments, and badlands along the eastern edge of the survey area. Slopes are medium in length and are convex. The native vegetation is mainly ponderosa pine and grasses with scattered junipers.

This unit is 35 percent Shingle loam, thin solum; 25 percent Rock outcrop; and 20 percent Tassel loamy fine sand, thin solum. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Samday clay loam, Tullock loamy sand, and Vonalee loamy sand. Also included are small areas of Samday soils that are less than 10 inches thick. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Shingle soil is very shallow and well drained. It formed in loamy residuum derived from interbedded, noncalcareous shale and sandstone. Typically, the surface layer is light gray loam about 2 inches thick. The underlying material to a depth of 9 inches is grayish brown clay loam.

Permeability of the Shingle soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 10 inches. Runoff is rapid, and the hazard of water

erosion is severe. The hazard of wind erosion is moderate.

Rock outcrop is soft, mostly noncalcareous shale and sandstone with seams of coal and ironstone.

The Tassel soil is very shallow and well drained. It formed in loamy residuum derived dominantly from noncalcareous sandstone. Typically, the surface layer is pale brown loamy fine sand about 2 inches thick. The underlying material to a depth of 8 inches is light yellowish brown and light olive brown sandy loam. Depth to noncalcareous sandstone ranges from 5 to 10 inches.

Permeability of the Tassel soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 5 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The Shingle and Tassel soils are poorly suited to the production of timber. The site index for ponderosa pine ranges from 20 to 30. These soils can produce 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The main concerns in producing and harvesting timber are the low density of the stands, the very shallow depth of the soils, slow regeneration, the hazard of erosion, and difficulty of harvesting. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Minimizing the risk of erosion is essential in harvesting timber. The very low available water capacity generally influences seedling survival in areas where understory plants are numerous. Conventional methods of harvesting timber are difficult to use because of slope.

The potential understory plant community on the Shingle and Tassel soils is mainly needleandthread, prairie sandreed, little bluestem, and bluebunch wheatgrass. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, annuals invade. The potential understory plant community produces about 600 pounds of air-dry vegetation in normal years. Production varies from 800 pounds in favorable years to 400 pounds in unfavorable years.

About 20 percent of this unit is scattered 5- to 10-acre clearings that support mainly range vegetation. The potential plant community in these clearings is mainly prairie sandreed, bluebunch wheatgrass, little bluestem, and western wheatgrass.

If the plant communities are overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Brush management improves deteriorated areas that are producing more woody shrubs than were present in the potential plant community. Livestock grazing should be managed to protect the soil from excessive erosion.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are slope and depth to soft bedrock. Mounded absorption fields should be constructed.

This map unit is in capability subclass VIIe. It is in woodland suitability group 2D1.

133—Shingle-Theedle-Cambria association, 6 to 30 percent slopes. This map unit is on ridge crests, back slopes, and pediment slopes of rolling to steep uplands. Slopes are medium in length and are convex. The native vegetation is mainly grasses and forbs.

This unit is 40 percent Shingle clay loam, 25 percent Theedle loam, and 25 percent Cambria sandy loam. The Shingle soil is in the more convex, moderately steep and steep areas. The Theedle and Cambria soils are in the less convex, moderately sloping areas.

Included in this unit are small areas of Samday clay loam and Rock outcrop. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay loam. Soft shale is at a depth of 18 inches.

Permeability of the Shingle soil is moderate. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Theedle soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown loam about 5 inches thick. The underlying material to a depth of 23 inches is light gray loam and light brownish gray clay loam. Soft shale is at a depth of 28 inches. In some areas shale is at a depth of 40 to 60 inches or more.

Permeability of the Theedle soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from shale and sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 4 inches of the subsoil is yellowish brown loam, and the lower part to a depth of 60 inches or more is pale brown and brown loam. In a few areas, bedrock is at a depth of 40 to 60 inches.

Permeability of the Cambria soil is moderate. Available water capacity is high. Effective rooting depth is 60

inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Shingle soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on the Shingle soil is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this soil for rangeland seeding is poor. The main limitations are restricted rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Theedle and Cambria soils is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on Theedle and Cambria soils is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

The Shingle soil is poorly suited to homesite development. The main limitations are moderate shrink-swell potential, slope, and depth to soft bedrock. If the Theedle soil is used for homesite development, the main limitations are moderate shrink-swell potential, slope, and depth to soft bedrock. If the Cambria soil is used for homesite development, the main limitations are slope and moderate shrink-swell potential. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Septic tank absorption lines in the Cambria soil operate best if placed deep in the subsoil. Areas of the Shingle and Theedle soils are not suitable for use as absorption fields.

The Shingle soil is in capability subclass VIIe, and the Theedle and Cambria soils are in capability subclass VIe, nonirrigated. The Shingle soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site. The Theedle and Cambria soils are in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

134—Silhouette-Heldt association, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on alluvial flats, toe slopes, and foot slopes. Slopes are long and are plane to slightly concave. The Silhouette soils are on foot slopes and the outer margins of alluvial flats, and the Heldt soils are on toe slopes and at the center of alluvial flats. The native vegetation is mainly grasses.

This unit is 50 percent Silhouette clay loam and 35 percent Heldt clay loam.

Included in this unit are small areas of Bidman sandy loam, Ulm loam, and Zigweid loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Silhouette soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 2 inches thick. The upper part of the subsoil is pale brown clay about 20 inches thick, and the lower part to a depth of 48 inches or more is very pale brown clay and light gray clay loam. In a few areas, soft shale is at a depth of 20 to 40 inches.

Permeability of the Silhouette soil is slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

The Heldt soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is light gray clay loam about 1 inch thick. The subsoil is light brownish gray clay about 18 inches thick. The substratum to a depth of 60 inches or more is pale brown and very pale brown clay. Cracks as much as 0.5 inch wide extend to a depth of 20 inches when the soil is dry.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, green needlegrass, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti and broom snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are high shrink-swell potential and slow permeability. Backfilling excavations with coarser textured material reduces the shrink-swell potential. Constructing a larger absorption field helps to compensate for the slow permeability.

This unit is in capability subclass IVe. It is in the Clayey, 10- to 14-inch ppt., Northern Plains range site.

135—Tassel-Shingle complex, 6 to 30 percent slopes. This map unit is on ridgetops and shoulder slopes in undulating to steep areas on uplands and on partially stabilized escarpments. Slopes are medium in length and are convex. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Tassel fine sandy loam and 30 percent Shingle clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Samday clay loam, Rock outcrop, Worf loamy sand, Worfka fine sandy loam, and Theedle loam. Also included are small areas of Gateson Variant and Tassel Variant soils along Pine Ridge and small areas of Shingle soils, thin solum, and Tassel soils, thin solum, along the eastern county line. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Tassel soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is pale brown fine sandy loam about 3 inches thick. The underlying material to a depth of 14 inches is pale brown and light yellowish brown fine sandy loam. Soft sandstone is at a depth of 14 inches.

Permeability of the Tassel soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay loam. Soft shale is at a depth of 18 inches.

Permeability of the Shingle soil is moderate. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Tassel soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,000 pounds of air-dry vegetation in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Shingle soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage on this unit is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are limited rooting depth and the hazards of wind and water erosion. Areas that are

heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are depth to soft bedrock and slope. Absorption fields should be constructed using selected material.

This map unit is in capability subclass VIIe. The Tassel soil is in the Shallow Sandy, 10- to 14-inch ppt., Northern Plains range site. The Shingle soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site.

136—Tassel-Terro-Rock outcrop complex, 15 to 30 percent slopes. This map unit is in hilly to steep areas on upland ridgetops, shoulder slopes, and back slopes. Slopes are convex and are medium in length. The native vegetation is mainly grasses and shrubs.

This unit is 40 percent Tassel loamy fine sand, 20 percent Terro sandy loam, and 20 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Tullock loamy sand and Turnback loamy fine sand on the upper part of hill slopes and Keeline sandy loam on the lower part of hill slopes. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Tassel soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is grayish brown loamy fine sand about 2 inches thick. The underlying material to a depth of 16 inches is pale brown fine sandy loam. Soft calcareous sandstone is at a depth of 16 inches.

Permeability of the Tassel soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Terro soil is moderately deep and somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 6 inches of the subsoil is brown sandy loam, and the lower 24 inches is pale brown and light gray sandy loam. Soft sandstone is at a depth of 34 inches. A few areas have soft bedrock at a depth of 40 to 60 inches or more.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

Rock outcrop is exposures of mostly soft, calcareous sandstone on knolls and narrow ridges.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Tassel soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,000 pounds of air-dry vegetation in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Terro soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation and limited rooting depth. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are the hazards of wind and water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are slope and depth to soft bedrock. Mounded septic tank absorption fields should be installed in the less sloping areas, and selected material should be used.

This map unit is in capability subclass VIIe. The Tassel soil is in the Shallow Sandy, 10- to 14-inch ppt., Northern Plains range site. The Terro soil is in the Sandy, 10- to 14-inch ppt., Northern Plains range site. Rock outcrop is not placed in a range site.

137—Tassel-Tullock-Vonalee association, 6 to 30 percent slopes. This map unit is on ridges and hill slopes in an area of rolling to steep uplands. Slopes are

medium in length and are convex. The native vegetation is mainly grasses and shrubs.

This unit is 40 percent Tassel loamy fine sand, 20 percent Tullock loamy sand, and 20 percent Vonalee loamy sand. The Tassel soil has slopes of 6 to 30 percent, the Tullock soil has slopes of 6 to 20 percent, and the Vonalee soil has slopes of 6 to 15 percent.

Included in this unit are small areas of Bowbac sandy loam, Turnback sandy loam, and Keeline sandy loam and small areas of sandstone Rock outcrop. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Tassel soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is grayish brown loamy fine sand about 2 inches thick. The underlying material to a depth of 16 inches is pale brown fine sandy loam. Soft calcareous sandstone is at a depth of 16 inches.

Permeability of the Tassel soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Tullock soil is moderately deep and excessively drained. It formed in sandy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown loamy sand about 5 inches thick. The upper 15 inches of the underlying material is brown sand, and the lower part to a depth of 31 inches is pale brown loamy sand. Soft sandstone is at a depth of 31 inches. In a few areas, bedrock is at a depth of 40 to 60 inches or more.

Permeability of the Tullock soil is rapid. Available water capacity is very low to low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Vonalee soil is deep and somewhat excessively drained. It formed in loamy, wind-worked residuum derived dominantly from calcareous sandstone. Typically, the surface layer is dark grayish brown loamy sand about 3 inches thick. The upper 16 inches of the subsoil is light yellowish brown sandy loam, and the lower 5 inches is pale brown sandy loam. The substratum to a depth of 60 inches or more is pale brown loamy sand. In a few areas, soft bedrock is at a depth of 20 to 60 inches.

Permeability of the Vonalee soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Tassel soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,000 pounds of air-dry vegetation in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The production of forage on the Tassel soil is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Tassel soil for rangeland seeding is poor. The main limitations are limited rooting depth and the hazards of erosion by wind and water. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The Tassel soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Tullock soil is mainly prairie sandreed, sand bluestem, needleandthread, and Indian ricegrass. As the range condition deteriorates, sageworts increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 2,000 pounds of air-dry vegetation in normal years. Production varies from 2,500 pounds in favorable years to 1,400 pounds in unfavorable years.

The production of forage on the Tullock soil is limited by droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Tullock soil for rangeland seeding is poor. The main limitations are the hazard of wind erosion, droughtiness, and slope. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The Tullock soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Vonalee soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on the Vonalee soil is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and

the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Vonalee soil for rangeland seeding is fair. The main limitations are the hazards of wind and water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The Vonalee soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

The Tassel and Tullock soils are poorly suited to homesite development. The main limitations are slope, depth to soft bedrock, and the hazard of sand blowing. If the Vonalee soil is used for homesite development, the main limitation is slope. Areas of the Vonalee soil are most suitable for use as septic tank absorption fields.

The Tassel soil is in capability subclass VIIe. The Tullock and Vonalee soils are in capability subclass VIe. The Tassel soil is in the Shallow Sandy, 10- to 14-inch ppt., Northern Plains range site. The Tullock soil is in the Sands, 10- to 14-inch ppt., Northern Plains range site. The Vonalee soil is in the Sandy, 10- to 14-inch ppt., Northern Plains range site.

138—Terro-Tullock-Orpha complex, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on upland summits and superimposed dunes. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 35 percent Terro sandy loam, 30 percent Tullock loamy sand, and 20 percent Orpha loamy sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Turnback sandy loam, Keeline sandy loam, and Bowbac sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Terro soil is moderately deep and somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 6 inches of the subsoil is brown sandy loam, and the lower 24 inches is pale brown and light gray sandy loam. Soft sandstone is at a depth of 34 inches. In a few areas, soft bedrock is at a depth of 40 to 60 inches or more.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Tullock soil is moderately deep and excessively drained. It formed in sandy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown loamy sand about 5 inches thick. The upper 15 inches of the underlying material is brown sand, and the lower part to a depth of 31 inches is pale brown loamy sand. Soft sandstone is at a depth of 31 inches.

Permeability of the Tullock soil is rapid. Available water capacity is very low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Orpha soil is deep and excessively drained. It formed in eolian sand derived from mixed sources. Typically, the surface layer is pale brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown loamy sand. In some areas carbonates are above a depth of 40 inches.

Permeability of the Orpha soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Terro soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on the Terro soil is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Terro soil for rangeland seeding is good. The main limitation is the hazard of wind erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The Terro soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Tullock and Orpha soils is mainly prairie sandreed, sand bluestem, needleandthread, and Indian ricegrass. As the range condition deteriorates, sageworts increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 2,000 pounds of air-dry vegetation in normal years. Production varies from 2,500 pounds in favorable years to 1,400 pounds in unfavorable years.

The production of forage on the Tullock and Orpha soils is limited by droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Tullock and Orpha soils for rangeland seeding is poor. The main limitations are the hazard of wind erosion and droughtiness. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The Tullock and Orpha soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are depth to soft bedrock, the hazard of sand blowing, and the hazard of excavations caving in. Areas of the Orpha soil are most suitable for use as septic tank absorption fields.

This map unit is in capability subclass VIe. The Terro soil is in the Sandy, 10- to 14-inch ppt., Northern Plains range site. The Tullock and Orpha soils are in the Sands, 10- to 14-inch ppt., Northern Plains range site.

139—Terro-Tullock-Orpha complex, 6 to 15 percent slopes. This map unit is on ridgetops, shoulders, and back slopes of rolling uplands and on superimposed dunes. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 35 percent Terro sandy loam, 30 percent Tullock loamy sand, and 20 percent Orpha loamy sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Turnback sandy loam and Keeline sandy loam on ridges and shoulder slopes. Also included are small areas of Tassel loamy fine sand on ridgetops and Vonalee loamy sand on the lower part of hill slopes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Terro soil is moderately deep and somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 6 inches of the subsoil is brown sandy loam, and the lower 24 inches is pale brown and light gray sandy loam. Soft sandstone is at a depth of 34 inches.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Tullock soil is moderately deep and excessively drained. It formed in sandy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown loamy sand about 5 inches thick. The upper 15 inches of the underlying material is brown sand, and the lower part to a depth of 31 inches is pale brown loamy sand. Soft sandstone is at a depth of 31 inches.

Permeability of the Tullock soil is rapid. Available water capacity is very low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Orpha soil is deep and excessively drained. It formed in eolian sand derived from mixed sources. Typically, the surface layer is pale brown loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown loamy sand. In a few areas, carbonates are above a depth of 40 inches.

Permeability of the Orpha soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Terro soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage on the Terro soil is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of the Terro soil for rangeland seeding is fair. The main limitations are the hazards of wind and water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The Terro soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The potential plant community on the Tullock and Orpha soils is mainly prairie sandreed, sand bluestem, needleandthread, and Indian ricegrass. As the range condition deteriorates, sageworts increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 2,000 pounds of air-dry vegetation in normal years. Production varies from 2,500 pounds in favorable years to 1,400 pounds in unfavorable years.

The production of forage on the Tullock and Orpha soils is limited by droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is poor. The main limitations are the hazard of wind erosion and droughtiness. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are depth to soft bedrock and the hazard of excavations caving in. Areas of the Terro and Tullock soils are not suitable for use as septic tank absorption fields.

This map unit is in capability subclass VIe. The Terro soil is in the Sandy, 10- to 14-inch ppt., Northern Plains range site. The Tullock and Orpha soils are in the Sands, 10- to 14-inch ppt., Northern Plains range site.

140—Theedle-Kishona association, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on alluvial flats, foot slopes, and toe slopes adjacent to rolling uplands. Slopes are medium to long in length and are slightly convex. The native vegetation is mainly grasses.

This unit is 45 percent Theedle loam and 35 percent Kishona loam. The Theedle soil is in the more convex areas, and the Kishona soil is in the more nearly plane areas.

Included in this unit are small areas of Cambria fine sandy loam, Bahl clay, and Cushman loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Theedle soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown loam about 5 inches thick. The underlying material to a depth of 28 inches is light gray loam and light brownish gray clay loam. Soft shale is at a depth of 28 inches.

Permeability of the Theedle soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

The Kishona soil is deep and well drained. It formed in loamy local residuum derived dominantly from calcareous shale. Typically, the surface layer is brown loam about 3 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and light gray clay loam.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are depth of the Theedle soil to soft bedrock and moderate shrink-swell potential. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Areas of the Kishona soil are most suitable for use as septic tank absorption fields.

This map unit is in capability subclass IVe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

141—Theedle-Kishona association, 6 to 15 percent slopes. This map unit is on pediment slopes in areas of rolling uplands and on alluvial fans adjacent to upland escarpments. Slopes are short and convex. The native vegetation is mainly grasses.

This unit is 55 percent Theedle loam and 25 percent Kishona loam. The Theedle soil is in the more convex areas, and the Kishona soil is in the more nearly level areas.

Included in this unit are small areas of Cambria sandy loam, Savageton clay loam, and Shingle clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Theedle soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown loam about 5 inches thick. The underlying material to a depth of 28 inches is light gray loam and light brownish gray clay loam. Soft shale is at a depth of 28 inches.

Permeability of the Theedle soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

The Kishona soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is brown loam about 3 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and light gray clay loam.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are slope, depth of the Theedle soil to soft bedrock, and moderate shrink-swell potential. Backfilling excavations with coarser textured material reduces the limitation of shrink-swell potential. Areas of the Kishona soil are more suitable for use as septic tank absorption fields.

This map unit is in capability subclass VIe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

142—Ulm-Bidman complex, 0 to 6 percent slopes. This map unit is on alluvial flats and in level to undulating areas on foot slopes and toe slopes. Slopes are long and are plane to concave. The native vegetation is mainly grasses and shrubs.

This unit is 45 percent Ulm clay loam and 40 percent Bidman sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Forkwood fine sandy loam, Bahl clay, and Absted fine sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Ulm soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale brown clay loam about 4 inches thick. The upper 13 inches of the subsoil is pale brown clay and pale brown clay loam, and the lower part to a depth of 60 inches or more is light yellowish brown clay loam.

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

The Bidman soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray sandy loam about 3 inches thick. The subsurface layer is pale brown sandy loam about 4 inches thick. The upper 13 inches of the subsoil is light brownish gray clay, and the lower 28 inches is light brownish gray clay loam. The substratum to a depth of 60 inches or more is light brownish gray clay loam.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Ulm soil is mainly western wheatgrass, green needlegrass, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti and broom snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The potential plant community on the Bidman soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are high shrink-swell potential and slow permeability. Backfilling excavations with coarser textured material reduces the limitation of shrink-swell potential. Constructing a larger absorption field helps to compensate for the slow permeability.

This map unit is in capability subclass IVe. The Ulm soil is in the Clayey, 10- to 14-inch ppt., Northern Plains range site. The Bidman soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

143—Ulm-Renohill complex, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on foot slopes and toe slopes. Slopes are medium to long in length and are plane to concave. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Ulm loam and 40 percent Renohill fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Forkwood fine sandy loam, Zigweid clay loam, and Cambria fine sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Ulm soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is brown loam about 5 inches thick. The upper 16 inches of the subsoil is brown clay loam and clay, and the lower part to a depth of 60 inches or more is pale brown clay loam and light yellowish brown sandy clay loam. In some areas the surface layer is sandy loam.

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

The Renohill soil is moderately deep and well drained. It formed in clayey residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown fine sandy loam about 5 inches thick. The upper 15 inches of the subsoil is brown clay, and the lower 16 inches is pale brown clay loam. Calcareous shale is at a depth of 36 inches. In some areas the surface layer is thinner than is typical and has an abrupt boundary with the subsoil.

Permeability of the Renohill soil is slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Ulm soil is mainly western wheatgrass, green needlegrass, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti and broom snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The potential plant community on the Renohill soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that

the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are high shrink-swell potential, slow permeability, and the depth of the Renohill soil to soft bedrock. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Constructing a larger septic tank absorption field helps to compensate for the slow permeability. Areas of the Renohill soil are not suitable for use as septic tank absorption fields.

This map unit is in capability subclass IVe. The Ulm soil is in the Clayey, 10- to 14-inch ppt., Northern Plains range site. The Renohill soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

144—Ulm-Renohill clay loams, 6 to 15 percent slopes. This map unit is on ridges and hill slopes in areas of rolling uplands and on adjacent foot slopes. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 45 percent Ulm clay loam and 45 percent Renohill clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Shingle clay loam and Worfka fine sandy loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Ulm soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The upper 12 inches of the subsoil is brown clay loam, and the lower part to a depth of 60 inches or more is light gray clay loam. In some areas the surface layer is sandy loam, and in some areas the subsoil is sandy clay.

Permeability of the Ulm soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Renohill soil is moderately deep and well drained. It formed in clayey residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 5 inches thick. The subsoil is light brownish gray clay loam about 20 inches thick. Calcareous, gritty shale is at a depth of 25 inches. In some areas the surface layer is sandy loam.

Permeability of the Renohill soil is moderately slow. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, green needlegrass, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti and broom snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are high shrink-swell potential, slow permeability, slope, and the depth of the Renohill soil to soft bedrock. Backfilling excavations with coarser textured material reduces the limitation of shrink-swell potential. Constructing a larger absorption field helps to compensate for the slow permeability. Areas of the Renohill soil are not suitable for use as septic tank absorption fields.

This map unit is in capability subclass VIe. It is in the Clayey, 10- to 14-inch ppt., Northern Plains range site.

145—Ustic Torriorthents, reclaimed, 3 to 30 percent slopes. These deep, well drained soils consist of reclaimed areas around coal and uranium strip mines and porcellanite borrow areas. They formed in an overburden derived from mining operations.

Typically, the profile to a depth of 60 inches or more is strong brown to light gray loamy sand to clay loam. In some areas layers of rearranged coal and shale are at a depth of less than 60 inches.

Permeability of these soils is slow to moderately rapid. Available water capacity is low to moderate. Effective rooting depth is 60 inches or more. Runoff is medium to

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

This unit is used for livestock grazing and wildlife habitat.

A common plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, big sagebrush, and fourwing saltbush. As the range condition deteriorates, Russian-thistle, cheatgrass, buffalobur, kochia, and Japanese brome increase.

This unit responds well to fertilizer, range seeding, and proper grazing use. The main limitation for seeding is the reaction of the soil, which ranges from 3.8 to 8.4 in various layers. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Management practices suitable for use on this unit include proper range use, deferred grazing, mowing, rotation grazing, and aerial spraying for brush management. Livestock grazing should be managed to protect the soil from excessive erosion.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This map unit is in capability subclass VIe. It is not placed in a range site.

146—Vonalee-Terro complex, 0 to 6 percent slopes. This map unit is in nearly level to gently sloping areas on pediment slopes adjacent to rolling uplands and on stream terraces. Slopes are medium to long in length and are plane to slightly convex. The native vegetation is mainly grasses and shrubs.

This unit is 50 percent Vonalee loamy sand and 35 percent Terro sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Hiland sandy loam, Turnback sandy loam, and Keeline sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Vonalee soil is deep and somewhat excessively drained. It formed in loamy, wind-worked residuum and local alluvium derived from mixed sources. Typically, the surface layer is yellowish brown loamy sand about 4 inches thick. The upper 20 inches of the subsoil is yellowish brown and grayish brown sandy loam. The subsoil to a depth of 60 inches or more is brown loamy sand and light brownish gray sandy clay loam. In some areas soft sandstone is at a depth of 40 to 60 inches.

Permeability of the Vonalee soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Terro soil is moderately deep and somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 6 inches of the subsoil is brown sandy loam, and the lower 24 inches is pale brown and light gray sandy loam. Soft, calcareous sandstone is at a depth of 34 inches.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of wind erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are the depth of the Terro soil to soft bedrock and the hazard of excavations caving in. Areas of the Vonalee soil are more suitable for use as septic tank absorption fields.

This map unit is in capability subclass IVe. It is in the Sandy, 10- to 14-inch ppt., Northern Plains range site.

147—Vonalee-Terro complex, 6 to 15 percent slopes. This map unit is on ridges and back slopes of rolling uplands. Slopes are short and convex. The native vegetation is mainly grasses and shrubs.

This unit is 45 percent Vonalee loamy sand and 40 percent Terro sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bowbac sandy loam, Turnback sandy loam, and Keeline sandy loam. Included areas make up about 15 percent of the total

acreage. The percentage varies from one area to another.

The Vonalee soil is deep and somewhat excessively drained. It formed in loamy wind-worked residuum derived dominantly from calcareous sandstone. Typically, the surface layer is dark grayish brown loamy sand about 3 inches thick. The upper 16 inches of the subsoil is light yellowish brown sandy loam, and the lower 5 inches is pale brown sandy loam. The substratum to a depth of 60 inches or more is pale brown sandy loam.

Permeability of the Vonalee soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Terro soil is moderately deep and somewhat excessively drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 6 inches of the subsoil is brown sandy loam, and the lower 24 inches is pale brown and light gray sandy loam and loamy sand. Soft, calcareous sandstone is at a depth of 34 inches.

Permeability of the Terro soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, sageworts and needleleaf sedge increase. As the range condition further deteriorates, annuals and broom snakeweed invade. The potential plant community produces about 1,600 pounds of air-dry vegetation in normal years. Production varies from 2,100 pounds in favorable years to 1,000 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitations are the hazards of wind and water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are slope, depth of the Terro soil to soft bedrock, and the hazard of excavations caving in. Areas of the Vonalee soil are more suitable for use as septic tank absorption fields.

This map unit is in capability subclass VIe. It is in the Sandy, 10- to 14-inch ppt., Northern Plains range site.

148—Wibaux-Rock outcrop-Shingle complex, 6 to 45 percent slopes. This map unit is on steep porcellanite-capped buttes and rolling shale uplands. Slopes are short to medium in length and are plane to convex. The native vegetation is mainly grasses and forbs.

This unit is 35 percent Wibaux channery loam, 30 percent Rock outcrop, and 20 percent Shingle clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Renohill clay loam and Sear loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Wibaux soil is shallow and somewhat excessively drained. It formed in channery residuum derived dominantly from fragmented porcellanite. Typically, the surface layer is pinkish gray channery loam about 4 inches thick. The underlying material to a depth of 11 inches is light brown very channery loam. Fragmented porcellanite in which soil partially fills voids is at a depth of 11 to 60 inches or more.

Permeability of the Wibaux soil is moderate to a depth of 11 inches and very rapid below this depth. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

Rock outcrop is exposures of shale and siltstone on scarp slopes.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from shale. Typically, the surface layer is pale brown clay loam about 4 inches thick. The underlying material to a depth of 13 inches is light brownish gray clay loam. Soft, interbedded shale and sandstone are at a depth of 13 inches.

Permeability of the Shingle soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Wibaux and Shingle soils is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further

deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The production of forage is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of these soils for rangeland seeding is poor. The main limitations are restricted rooting depth and the hazard of water erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitation is the depth to soft bedrock or fragmented porcellanite. Septic tank absorption fields should be constructed using selected material.

This map unit is in capability subclass VIIe. The Wibaux soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site. Rock outcrop is not assigned a range site. The Shingle soil is in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site.

149—Worf-Shingle-Tassel complex, 3 to 30 percent slopes. This map unit is on ridgetops and shoulder slopes of undulating to steep uplands and on partially stabilized escarpments. Slopes are medium in length and are convex. The native vegetation is mainly grasses and shrubs.

This unit is 35 percent Worf loamy sand, 30 percent Shingle clay loam, and 20 percent Tassel fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Theedle loam, Cushman loam, Samday clay loam, and Worfka fine sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Worf soil is shallow and well drained. It formed in loamy residuum derived dominantly from interbedded shale and sandstone. Typically, the surface layer is light brownish gray loamy sand about 5 inches thick. The subsoil is brown and yellowish brown clay loam about 10 inches thick. Calcareous shale and sandstone are at a depth of 15 inches.

Permeability of the Worf soil is moderate. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Shingle soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is light brownish gray clay loam about 4 inches thick. The underlying material to a depth of 18 inches is light brownish gray clay loam. Soft shale is at a depth of 18 inches.

Permeability of the Shingle soil is moderate. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Tassel soil is shallow and well drained. It formed in loamy residuum derived dominantly from calcareous sandstone. Typically, the surface layer is pale brown fine sandy loam about 3 inches thick. The underlying material to a depth of 14 inches is pale brown and light yellowish brown fine sandy loam. Soft sandstone is at a depth of 14 inches.

Permeability of the Tassel soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Worf and Shingle soils is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and cacti invade. The potential plant community produces about 900 pounds of air-dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 450 pounds in unfavorable years.

The potential plant community on the Tassel soil is mainly needleandthread, prairie sandreed, Indian ricegrass, and little bluestem. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,000 pounds of air-dry vegetation in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The production of forage on this unit is limited by restricted rooting depth and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are restricted rooting depth and the hazards of erosion by wind and water. Areas

that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

This unit is poorly suited to homesite development. The main limitations are slope and depth to soft bedrock. Septic tank absorption fields should be installed in the less sloping areas, and selected material should be used.

This map unit is in capability subclass VIIe. The Worf and Shingle soils are in the Shallow Loamy, 10- to 14-inch ppt., Northern Plains range site. The Tassel soil is in the Shallow Sandy, 10- to 14-inch ppt., Northern Plains range site.

150—Zigweid-Bahl association, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on alluvial flats and toe slopes adjacent to rolling uplands. Slopes are long and plane. The native vegetation is mainly grasses and shrubs.

This unit is 55 percent Zigweid loam and 30 percent Bahl clay. The Zigweid soil is on toe slopes, and the Bahl soil is on alluvial flats.

Included in this unit are small areas of Cambria fine sandy loam, Ulm clay loam, Theedle loam, and Haverdad fine sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Zigweid soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is grayish brown loam about 2 inches thick. The subsoil is grayish brown and light brownish gray clay loam about 33 inches thick. The substratum to a depth of 60 inches or more is light brownish gray clay loam. In a few areas soft shale is at a depth of 40 to 60 inches.

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

The Bahl soil is deep and well drained. It formed in clayey local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale olive clay about 4 inches thick. The underlying material to a depth of 60 inches or more is pale olive clay.

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

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Zigweid soil is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The potential plant community on the Bahl soil is mainly western wheatgrass, thickspike wheatgrass, and green needlegrass. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti and broom snakeweed invade. The potential plant community produces about 1,300 pounds of air-dry vegetation in normal years. Production varies from 1,800 pounds in favorable years to 750 pounds in unfavorable years.

The production of forage on this unit is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are the slow permeability of the Bahl soil and shrink-swell potential. Constructing a larger absorption field helps to compensate for the slow permeability. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential.

This map unit is in capability subclass IVe. The Zigweid soil is in the Loamy, 10- to 14-inch ppt., Northern Plains range site. The Bahl soil is in the Clayey, 10- to 14-inch ppt., Northern Plains range site.

151—Zigweid-Cambria association, 0 to 6 percent slopes. This map unit is in nearly level to undulating areas on foot slopes and toe slopes adjacent to rolling uplands. Slopes are medium to long in length and are plane to slightly convex. The native vegetation is mainly grasses and shrubs.

This unit is 55 percent Zigweid clay loam and 30 percent Cambria fine sandy loam. The Zigweid soil is in the plane areas, and the Cambria soil is in the convex areas.

Included in this unit are small areas of Theedle loam and Bahl clay. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Zigweid soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is brown clay loam about 3 inches thick. The subsoil is pale brown and light brownish gray clay loam to a depth of 60 inches or more. In a few areas, soft bedrock is at a depth of 40 to 60 inches.

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

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from shale and sandstone. Typically, the surface layer is grayish brown fine sandy loam about 2 inches thick. The upper 8 inches of the subsoil is brown sandy clay loam, and the lower 19 inches is pale brown sandy clay loam and loam. The substratum to a depth of 60 inches or more is pale brown sandy clay loam.

Permeability of the Cambria soil capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is good. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitation is moderate shrink-swell potential. Backfilling excavations with coarser textured material helps to overcome this limitation. Septic tank absorption fields operative more effectively if they are placed deep in the subsoil.

This map unit is in capability subclass IVe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

152—Zigweid-Cambria-Theedle association, 6 to 15 percent slopes. This map unit is on pediment slopes of rolling uplands and on adjacent foot slopes. Slopes are short and are mostly convex. The native vegetation is mostly grasses and shrubs.

This unit is 35 percent Zigweid loam, 25 percent Cambria sandy loam, and 25 percent Theedle loam. The Zigweid soil is on the longer, more nearly plane slopes, the Cambria soil is on the intermediate slopes, and the Theedle soil is on the shorter, more convex slopes.

Included in this unit are small areas of Shingle clay loam, Bahl clay, and Renohill clay loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Zigweid soil is deep and well drained. It formed in loamy local alluvium derived dominantly from calcareous shale. Typically, the surface layer is pale brown loam about 4 inches thick. The subsoil to a depth of 60 inches or more is pale brown and very pale brown clay loam. In a few areas, soft bedrock is at a depth of 40 to 60 inches.

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

The Cambria soil is deep and well drained. It formed in loamy local alluvium and residuum derived dominantly from shale and sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper 4 inches of the subsoil is yellowish brown loam, and the lower 22 inches is pale brown loam. The substratum to a depth of 60 inches or more is brown loam.

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

The Theedle soil is moderately deep and well drained. It formed in loamy residuum derived dominantly from calcareous shale. Typically, the surface layer is pale brown loam about 5 inches thick. The underlying material to a depth of 28 inches is light gray loam and light brownish gray clay loam. Soft shale is at a depth of 28 inches.

Permeability of the Theedle soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, thickspike wheatgrass, and

needleandthread. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, cacti, annuals, and broom snakeweed invade. The potential plant community produces about 1,500 pounds of air-dry vegetation in normal years. Production varies from 2,000 pounds in favorable years to 850 pounds in unfavorable years.

The production of forage is limited by low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for rangeland seeding is fair. The main limitation is the hazard of water erosion. Chiseling or other such practices can be used to improve areas of deteriorated rangeland. Such practices increase water infiltration, reduce plant competition, and allow the desirable native plants to increase. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The vegetation on this unit provides some food for antelope, deer, small mammals, and birds.

If this unit is used for homesite development, the main limitations are shrink-swell potential, slope, and the depth of the Theedle soil to soft bedrock. Backfilling excavations with coarser textured material helps to overcome the limitation of shrink-swell potential. Septic tank absorption fields in the Zigweid and Cambria soils operate most effectively if placed deep in the subsoil; areas of the Theedle soil are not suitable for this use.

This map unit is in capability subclass VIe. It is in the Loamy, 10- to 14-inch ppt., Northern Plains range site.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section, and the system of land capability classification used by the Soil Conservation Service is explained.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a moderate level of management are given in the section "Detailed Soil Map Units" for those soils that are used for crops. About 1,000 acres is used for small grain. In any given year, yields may be higher or lower than those indicated because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen and phosphorus for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide more information about the management and productivity of the soils.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*6*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally

expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 4. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Robert E. Baumgartner, range conservationist, Soil Conservation Service, assisted in the preparation of this section.

Rangeland is land on which the potential plant community is dominantly native grasses, grasslike plants, forbs, and shrubs suitable for grazing or browsing. About 93 percent of the survey area is rangeland. The majority of farm income is derived from livestock, principally cattle. Cow-calf operations are dominant, and about 28 percent of all operations are cow-calf and sheep operations. About 65,000 head of cows and calves and 99,000 sheep are in the county.

On many ranches the forage produced on open rangeland is augmented by crested wheatgrass pasture. In winter the native forage is often supplemented by range cubes and hay. Creep feeding of calves and yearlings to increase their market weight is practiced on a few ranches.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal water table are also important. Range sites are given in the section "Detailed Soil Map Units."

Most of the survey area is characterized by undulating to hilly uplands of the Northern High Plains. The soils in these areas typically are moderately deep to deep. Those that have a loamy surface layer support mid grasses, and those that have a sandy surface layer support tall and mid grasses. The more convex ridges are dominated by shallow soils that have a loamy, sandy, or clayey surface layer and support mid and short grasses.

Less extensive, steep, badland-type areas are in the far eastern and western parts of the survey area. Shallow soils that have a clayey surface layer and support mid grasses are dominant. Nearly level and undulating upland flats in the Bill area are characterized by moderately deep to deep soils that have a loamy or clayey surface layer and support mid grasses. An area of rolling sandhills is northwest of Glenrock. The soils in this area have a sandy surface layer and support tall and mid grasses. Level to undulating sandy and loamy soils are along the middle and lower reaches of the major

streams. These soils support a high percentage of woody species.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

A list of the major grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community is given for each map unit description in the section "Detailed Soil Map Units." The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Among the more important range management practices on all rangeland in the survey area are proper grazing use and use of planned grazing systems, which include deferred grazing, proper season of use, and good distribution of grazing. Distribution of grazing can be accomplished with proper placement of salt and watering facilities and fencing where needed. The suitability of range improvement practices such as brush management, range seeding, and renovation depends on the characteristics of a given site.

Thunder Basin National Grassland

About 190,000 acres of federally administered land in the northeastern one-third of the survey area makes up the Thunder Basin National Grassland. Its boundaries occur in a checkerboard pattern among those of privately owned land.

The Thunder Basin National Grassland is one of 19 national grasslands in the Western United States. Most of it is flat to rolling prairie grassland.

During the late 1800's through the 1920's, much of this land was homesteaded under laws designed for the more arable land of the East. This homesteading resulted in the cultivation of 160- to 640-acre tracts of land that were unsuitable for this use and establishment of livestock operations on ranches too small to be economically successful. These land uses resulted in serious misuse and depletion of the basic resources of the prairie soil and the grass sod that protects it.

The Thunder Basin National Grassland was created through relief measures initiated by the Federal Government. The Agriculture Adjustment Administration initiated the Northeastern Wyoming Land Utilization Project in 1934 and purchased many of the drought-stricken homesteads. A rehabilitation program that consisted of establishing productive grasses on depleted lands to protect the soil and establishing livestock watering facilities to enhance grazing capacity was initiated. In 1954 the Northeastern Wyoming Land Utilization Project and intermingled and adjacent public lands were transferred to the Forest Service for administration and management. In 1960 these lands were designated as the Thunder Basin National Grassland and made a permanent part of the National Forest system.

Presently, about 40,000 cattle and sheep graze this grassland. Management objectives of national grasslands are development and execution of conservation and proper utilization programs for all renewable resources. This promotes the integration of Federally administered land with associated private and public lands into management units.

The Thunder Basin National Grassland has tremendous reserves of coal, oil, natural gas, and uranium. Currently, there are two operating coal mines and others under construction or in various licensing stages. There is one uranium mine in operation, and many oil and gas wells are scattered throughout the grassland.

This grassland supports a large population of American pronghorn antelope, deer, coyote, and other small mammals. It provides excellent habitat for raptors.

At least 17 species of eagles and hawks, including the golden eagle and bald eagle, commonly are observed during the year.

The main recreational use of the grassland is big game hunting, although it also provides excellent opportunities for hiking, botanizing, and birdwatching.

Additional information on the Thunder Basin National Grassland can be obtained from the local office of the Forest Service.

Woodland Management and Productivity

Richard C. Rintamaki, biologist, Soil Conservation Service, assisted in preparing this section.

There are no soils in the survey area suitable for the production of sawtimber. Some soils on Pine Ridge and along the eastern boundary of the survey area are suitable for limited production of timber for use as posts and fuelwood.

Major soil limitations need to be considered in management of these woodlands. The erosion hazard is severe, seedling mortality is severe, windthrow hazard is moderate, and plant competition is moderate. Ponderosa pine is suitable for planting.

Erosion hazard ratings indicate the risk of loss of soil in well managed woodland. The risk is slight if the expected soil loss is small, moderate if measures are needed to control erosion during logging and road construction, and severe if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of slight indicates that the expected mortality is less than 25 percent; moderate, 25 to 50 percent; and severe, more than 50 percent.

Windthrow hazard ratings are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of slight indicates that few trees may be blown down by strong winds; moderate, that some trees will be blown down during periods of excessive soil wetness and strong winds; and severe, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Plant competition ratings indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of slight indicates little or no competition from other plants; moderate indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; severe indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Understory vegetation is given for each map unit used as woodland in the section "Detailed Soil Map Units." The density of the plant cover should be about 20 percent to protect the soil.

Windbreaks and Environmental Plantings

Richard C. Rintamaki, biologist, Soil Conservation Service, assisted in preparing this section.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Trees do not occur naturally in most of the northern part of the survey area. Trees do occur naturally on the flood plains along the streams and on the shallow soil breaks in the northwestern and eastern parts of the area.

Before planting windbreaks, the purpose of the planting, suitability of the soils, adaptability of trees and shrubs to a site, and location of the windbreaks should be considered.

The establishment of windbreaks and the continued growth of the trees depend upon the careful selection of the site and of the trees and shrubs to be planted, adequate site preparation, and adequate maintenance of planted trees or seedlings. Grasses and weeds should be controlled before trees are planted, and regrowth of ground cover should be controlled during the life of the windbreaks. Some replanting generally is needed after the first or second year. A drip irrigation system ensures a higher rate of survival and promotes vigorous growth.

Windbreaks provide protection for an area about 20 times the height of the trees. Low-growing shrubs should be planted in the rows on the windward side, medium or tall shrubs should be planted in the next rows on the windward side, medium or tall shrubs in the next rows, and tall trees in the center, or in leeward rows. For maximum protection in winter, each windbreak should have two or more rows of evergreens such as Rocky Mountain juniper or ponderosa pine. If the moisture supply is adequate, Colorado blue spruce can be used advantageously. Evergreens live longer and provide more protection than broadleaf trees, but they are harder to establish and they grow more slowly.

Woody species used for windbreaks in the northern part of the survey area include trees such as Siberian elm, green ash, ponderosa pine, eastern redcedar, Russian-olive, eastern cottonwood, Austrian pine, honeylocust, Siberian crabapple, and Colorado blue spruce and shrubs such as lilac, Rocky Mountain juniper, Siberian peashrub, skunkbush sumac, chokeberry, and American plum.

The local office of the Soil Conservation Service can provide more information on the specific requirements of a particular soil.

Recreation

The soils of the survey area are rated in table 5 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 5, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 5 can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in table 7 and interpretations for septic tank absorption fields in table 8.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 6, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management,

and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are little bluestem, needleandthread, wheatgrass, and blue grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are cottonwood and willow. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine and Rocky Mountain juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wild rice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of hayland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grasses and legumes and wild herbaceous plants. The wildlife attracted to these areas include mourning dove, wild turkey, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, and mule deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, and shore birds.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, mule deer, sage grouse, meadowlark, golden eagle, badger, and coyote.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building Site Development, Sanitary Facilities, Construction Materials, and Water Management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and

construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps and soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 7 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the

content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 8 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 8 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Landfills must be able to bear heavy vehicular traffic, and they involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 8 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect landfills. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 9 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil

properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with calcium carbonate or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 9, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 10 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in

construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, subsidence of organic layers, and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 11 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area (*4*). Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under "Taxonomic Units and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 milcalcium carbonateters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (*1*) and the Unified soil classification system (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 milcalcium carbonateters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points)

across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 12 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under "Taxonomic Units and Their Morphology."

Clay as a soil separate consists of mineral soil particles that are less than 0.002 milcalcium carbonateter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 milcalcium carbonateters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 milcalcium carbonateters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the amount of

stable aggregates 0.84 milcalcium carbonateters in size. These are represented idealistically by USDA textural classes. Soils containing rock fragments can occur in any group.

1. Sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 12, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 milcalcium carbonateters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 13 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding.

Table 13 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on

the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 13 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in the table.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 14 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Aridisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Argid (*Arg*, meaning clay-rich horizon, plus *id*, from Aridisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplargids (*Hapl*, meaning minimal horizonation, plus *argid*, the suborder of the Aridisols that have a layer of clay accumulation).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Ustollic* identifies the subgroup that has more organic matter and receives more precipitation than the one that typifies the great group. An example is Ustollic Haplargids.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Ustollic Haplargids.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Taxonomic Units and Their Morphology

In this section, each taxonomic unit recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each taxonomic unit. A pedon, a small three-dimensional area of soil, that is typical or representative of the taxonomic unit in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*5*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*7*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the taxonomic unit.

The map units of each taxonomic unit are described in the section "Detailed Soil Map Units."

Absted Series

The Absted series consists of deep, well drained, slowly permeable soils on alluvial flats, toe slopes, and dissected terraces adjacent to major and minor drainageways. These soils formed in alluvial sediment derived from sedimentary rock. Slope is 0 to 6 percent.

Typical pedon of Absted fine sandy loam in an area of Absted-Arvada-Bone complex, 0 to 6 percent slopes, 1,250 feet east and 950 feet north of the southwest corner of sec. 30, T. 40 N., R. 68 W.

E—0 to 3 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak medium and coarse granular structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; abrupt smooth boundary.

Bt—3 to 14 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium and fine subangular blocky structure; continuous thick clay films on faces of peds; very hard, very firm, sticky and plastic; moderately alkaline; gradual smooth boundary.

Btnk—14 to 26 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong medium and fine subangular blocky structure; continuous thick clay films on faces of peds; very hard, very firm, sticky and plastic; violently effervescent; many medium soft masses of calcium carbonate; strongly alkaline; gradual wavy boundary.

Bnk—26 to 36 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; very hard, very firm, sticky and plastic; violently effervescent; many medium soft masses of calcium carbonate; strongly alkaline; gradual wavy boundary.

Bck—36 to 60 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; very hard, very firm, sticky and plastic; slightly effervescent; few fine soft masses of calcium carbonate; moderately alkaline.

The depth to calcium carbonate ranges from 12 to 28 inches.

The E horizon and the A horizon, where present, have hue of 2.5Y or 10YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3. Reaction is neutral or mildly alkaline.

The Btnk horizon has hue of 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. It is clay or clay loam that is 15 to 40 percent sand. The Btnk and Bnk horizons are moderately alkaline or strongly alkaline.

Aeric Haplaquepts

Aeric Haplaquepts are deep, poorly drained, very slowly permeable soils on playa lakebeds in areas characterized by centripetal drainage. These soils formed in clayey local alluvium derived from calcareous sedimentary rock. Slope is 0 to 3 percent.

Reference pedon of Aeric Haplaquepts clay loam in an area of Aeric Haplaquepts, 0 to 3 percent slopes, 800 feet south and 450 feet east of the northwest corner of sec. 15, T. 34 N., R. 71 W.

A—0 to 3 inches; light gray (10YR 6/1) clay loam, grayish brown (10YR 5/2) moist; weak fine granular structure; very hard, firm, sticky and plastic; common fine mottles; mildly alkaline; abrupt smooth boundary.

AC—3 to 8 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak fine subangular blocky structure; very hard, firm, sticky and plastic; few fine mottles; neutral; clear wavy boundary.

C1—8 to 20 inches; light gray (10YR 6/1) clay, grayish brown (10YR 5/2) moist; massive; very hard, firm, sticky and plastic; few fine mottles; mildly alkaline; gradual irregular boundary.

C2—20 to 30 inches; light gray (10YR 7/2) clay, pale brown (10YR 6/3) moist; massive; very hard, firm, very sticky and very plastic; few fine mottles and few medium iron and manganese concretions; strongly effervescent; few fine calcium carbonate concretions; mildly alkaline; gradual irregular boundary.

C3—30 to 48 inches; very pale brown (10YR 7/3) clay, grayish brown (10YR 5/2) moist; massive; very hard, very firm, very sticky and plastic; few fine mottles and few fine iron and manganese concretions; mildly alkaline.

Depth to bedrock typically is more than 60 inches, but it is as little as 20 inches in the smaller playas. Accumulation of carbonates and depth to them vary with the parent material. The control section is fine or fine-loamy.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 1 or 2. Texture is clay loam or clay. Reaction is neutral or mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 to 6 when moist, and chroma of 1 to 3. Reaction is mildly alkaline to strongly alkaline.

Arvada Series

The Arvada series consists of deep, well drained, slowly permeable soils on alluvial flats, toe slopes, and dissected terraces adjacent to major and minor drainageways. These soils formed in alluvial sediment derived from sedimentary rock. Slope is 0 to 6 percent.

Typical pedon of an Arvada loam in an area of Absted-Arvada-Bone complex, 0 to 6 percent slopes, 1,100 feet south and 1,000 feet east of the northwest corner of sec. 35, T. 41 N., R. 70 W.

A—0 to 3 inches; light brownish gray (10YR 6/2) loam, brown (10YR 5/3) moist; moderate fine platy structure parting to moderate very fine granular; soft, friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Btn1—3 to 7 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak medium and coarse prismatic structure parting to strong fine angular blocky; continuous thick clay films on faces of peds;

hard, friable, sticky and plastic; strongly alkaline; slightly effervescent; clear smooth boundary.
Btn2—7 to 15 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; strong fine angular blocky structure; continuous thick clay films on faces of peds; hard, friable, sticky and plastic; very strongly alkaline; slightly effervescent; clear wavy boundary.
Bk—15 to 22 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; slightly effervescent; moderately alkaline; clear wavy boundary.
C—22 to 48 inches; pale brown (10YR 6/3) clay, grayish brown (10YR 5/2) moist; massive; hard, friable, sticky and plastic; slightly effervescent; strongly alkaline.

The depth to calcium carbonate ranges from 0 to 12 inches.

The A horizon has hue of 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. Reaction is mildly alkaline to strongly alkaline.

The Btn horizons have hue of 2.5Y or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. They are typically clay or clay loam and are 10 to 40 percent sand. They are strongly alkaline or very strongly alkaline.

The C horizon is strongly alkaline or very strongly alkaline.

Bahl Series

The Bahl series consists of deep, well drained, slowly permeable soils on alluvial flats and toe slopes. These soils formed in local alluvium derived from calcareous shale. Slopes range from 0 to 6 percent.

Typical pedon of a Bahl clay in an area of Zigweid-Bahl association, 0 to 6 percent slopes, in the NE1/4NE1/4 of sec. 24, T. 40 N., R. 72 W.

A—0 to 4 inches; pale olive (5Y 6/3) clay, olive (5Y 5/3) moist; weak thick platy structure parting to weak medium and fine subangular blocky; hard, friable, sticky and plastic; strongly effervescent; moderately alkaline; gradual wavy boundary.
AC—4 to 9 inches; pale olive (5Y 6/3) clay, olive (5Y 5/3) moist; massive; hard, firm, sticky and plastic; strongly effervescent; strongly alkaline; gradual wavy boundary.
CK—9 to 40 inches; pale olive (5Y 6/3) clay, olive (5YR 5/3) moist; massive; hard, firm, sticky and plastic; strongly effervescent; few fine soft masses and filaments of calcium carbonate; strongly alkaline.

These soils typically are leached in the upper few inches, but in some areas they are calcareous throughout.

The A horizon has chroma of 2 or 3. Reaction is neutral to moderately alkaline.

The C horizon is mildly alkaline to strongly alkaline. The control section typically is about 45 percent clay and 15 to 25 percent sand.

Bidman Series

The Bidman series consists of deep, well drained, slowly permeable soils on alluvial flats, toe slopes, and foot slopes of upland hills. These soils formed in local alluvium derived from soft calcareous shale. Slope is 0 to 6 percent.

Typical pedon of a Bidman sandy loam in an area of Ulm-Bidman complex, 0 to 6 percent slopes, 2,500 feet east and 300 feet north of the southwest corner of sec. 1, T. 37 N., R. 68 W.

A—0 to 3 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; neutral; abrupt smooth boundary.
E—3 to 7 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.
Bt—7 to 20 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist and crushed; weak medium prismatic structure parting to strong medium and coarse angular blocky; very hard, firm, sticky and plastic; continuous thick clay films on faces of peds; neutral; clear wavy boundary.
Bk1—20 to 35 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few medium hard iron concretions; strongly effervescent; common medium and fine filaments and seams of calcium carbonate; moderately alkaline; gradual wavy boundary.
Bk2—35 to 52 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; few medium iron concretions; strongly effervescent; moderately alkaline; diffuse wavy boundary.
C—52 to 67 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable; slightly effervescent; moderately alkaline.

The depth to calcium carbonate ranges from 12 to 24 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 or 3. It is sandy loam or loam.

The Bt horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4. It is

dominantly clay, but the range includes clay loam and sandy clay. It averages 37 to 47 percent clay. Reaction is neutral to moderately alkaline.

The Bk horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. Texture is clay loam, sandy clay loam, or clay. Reaction is mildly alkaline to strongly alkaline.

Bigwinder Series

The Bigwinder series consists of deep, poorly drained, moderately permeable soils on flood plains and low stream terraces. These soils formed in recent stratified alluvium derived dominantly from sedimentary rock. Slope is 0 to 3 percent.

Typical pedon of a Bigwinder fine sandy loam in an area of Clarkelen-Haverdad-Bigwinder complex, 0 to 3 percent slopes; 1,250 feet north and 1,400 feet west of the southeast corner of sec. 24, T. 39 N., R. 75 W.

A—0 to 3 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; common fine strong brown (7.5YR 5/8) mottles along root channels; moderate thick platy structure; slightly hard, very friable, nonsticky and nonplastic; strongly effervescent; mildly alkaline; clear smooth boundary.

AC—3 to 8 inches; light gray (10YR 7/2), stratified sandy loam and loam, grayish brown (10YR 5/2) moist; common fine strong brown (7.5YR 5/8) mottles along root channels; weak thick platy structure; hard, friable, slightly sticky and plastic; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—8 to 17 inches; light gray (10YR 7/2), stratified loamy sand, loam, and sandy loam, pale brown (10YR 6/3) moist; common medium strong brown (7.5YR 5/8) mottles and faint organic stains on faces of fragments; massive; slightly hard, very friable, nonsticky and nonplastic; violently effervescent; moderately alkaline; clear wavy boundary.

C2—17 to 24 inches; light gray (10YR 7/2), stratified sandy loam and loamy sand, light brownish gray (10YR 6/2) moist; single grain; slightly hard, very friable, nonsticky and nonplastic; slightly effervescent; mildly alkaline; gradual smooth boundary.

C3—24 to 60 inches; mottled, light gray (10YR 7/2) and reddish yellow (7.5YR 6/8), stratified loamy sand, sandy loam, and sand, light brownish gray (10YR 6/2) and reddish yellow (5YR 6/8) moist; single grain; loose, nonsticky and nonplastic; slightly effervescent; mildly alkaline.

Depth to sand strata ranges from 30 to 40 inches.

The A horizon is fine sandy loam or sandy clay loam. Reaction is neutral to moderately alkaline. It has weak or moderate grades of platy structure.

The C horizon has value of 5 or 6 when moist. Matrix chroma is 2 or 3. Reaction is on mildly alkaline or moderately alkaline. Texture of the strata ranges from loam to sand.

Bone Series

The Bone series consists of deep, well drained, very slowly permeable soils on alluvial flats and toe slopes of dissected terraces adjacent to major and minor drainageways. These soils formed in alluvial sediment derived from sedimentary rock. Slope is 0 to 6 percent.

Typical pedon of a Bone clay loam in an area of Absted-Arvada-Bone complex, 0 to 6 percent slopes, 1,100 feet south and 500 feet west of the northeast corner of sec. 8, T. 36 N., R. 68 W.

E—0 to 2 inches; pale brown (10YR 6/3) light clay loam, brown (10YR 5/3) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; abrupt smooth boundary.

Bt—2 to 5 inches; light brownish gray (10YR 6/2) clay loam, brown (10YR 5/3) moist; moderate fine subangular blocky structure; few thin clay films on faces of peds; hard, friable, slightly sticky and slightly plastic; moderately alkaline; clear smooth boundary.

Bk—5 to 10 inches; light gray (10YR 7/2) clay loam, pale brown (10YR 6/3) moist; moderate fine subangular blocky structure; very hard, friable, sticky and plastic; strongly effervescent; calcium carbonate segregated in common fine soft masses; moderately alkaline; gradual smooth boundary.

C1—10 to 20 inches; very pale brown (10YR 7/3) heavy clay loam, pale brown (10YR 6/3) moist; massive; very hard, firm, sticky and plastic; strongly effervescent; calcium carbonate disseminated throughout matrix; very strongly alkaline; gradual smooth boundary.

C2—20 to 60 inches; very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; massive; very hard, friable, sticky and plastic; strongly effervescent; calcium carbonate disseminated throughout matrix; moderately alkaline.

The profile commonly is leached to a depth of 2 to 5 inches, or to the base of the Bt horizon, but many pedons are calcareous throughout. The solum has hue of 2.5Y or 10YR.

The E horizon has value of 6 or 7 when dry and 4 to 6 when moist. The Bt horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4. The Bk and C horizons are heavy clay loam or clay.

Bowbac Series

The Bowbac series consists of moderately deep, well drained, moderately permeable soils on shoulder slopes, back slopes, and pediment slopes of rolling uplands. These soils formed in residuum derived from soft sandstone. Slope is 0 to 15 percent.

Typical pedon of a Bowbac sandy loam (fig. 3) in an area of Hiland-Bowbac complex, 6 to 15 percent slopes, 2,450 feet north and 500 feet east of the southwest corner of sec. 27, T. 36 N., R. 70 W.

A—0 to 3 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure parting to single grain; soft, loose, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bt1—3 to 6 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; strong coarse subangular blocky structure parting to strong fine angular blocky; slightly hard, friable, sticky and plastic; few thin clay bridges between mineral grains; neutral; clear smooth boundary.

Bt2—6 to 18 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; strong coarse prismatic structure parting to strong fine subangular blocky; hard, friable, sticky and plastic; common moderately thick clay bridges between mineral grains; neutral; clear smooth boundary.

Btk—18 to 26 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; thin clay bridges between mineral grains; slightly effervescent; disseminated calcium carbonate; mildly alkaline; gradual wavy boundary.

Bk—26 to 36 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; weak coarse subangular blocky structure parting to weak very fine granular; soft, loose, slightly sticky and slightly plastic; strongly effervescent; disseminated calcium carbonate; moderately alkaline; gradual wavy boundary.

Cr—36 inches; soft calcareous sandstone.

The depth to calcium carbonate ranges from 14 to 26 inches. The depth to bedrock ranges from 24 to 37 inches.

The Bt horizon has chroma of 3 or 4. Texture is dominantly sandy clay loam that is 20 to 35 percent clay and more than 35 percent sand that is fine or coarser. The Bk horizon has hue of 2.5Y to 10YR, value of 6 or 7 when dry, and chroma of 2 to 4.

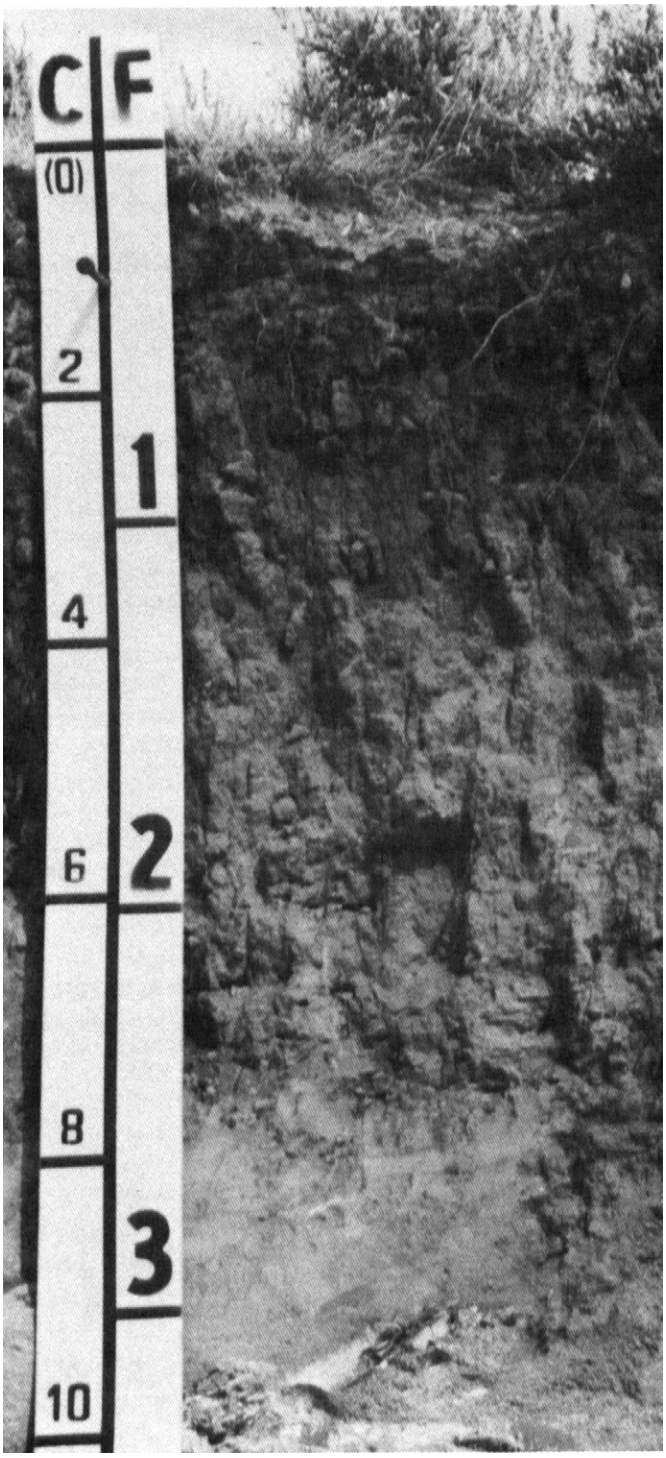


Figure 3.—Profile of Bowbac sandy loam. Soft sandstone is at depth of about 2.5 feet.

Cambria Series

The Cambria series consists of deep, well drained, moderately permeable soils on ridge crests, back slopes, foot slopes, and toe slopes of nearly level to rolling uplands. These soils formed in mixed residuum and local alluvium derived from shale and sandstone. Slope is 0 to 15 percent.

Typical pedon of a Cambria fine sandy loam in an area of Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes, 2,000 feet south and 500 feet east of the northwest corner of sec. 10, T. 36 N., R. 70 W.

A—0 to 2 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/3) moist; weak moderate subangular blocky structure parting to weak very fine granular; soft, very friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Bt1—2 to 4 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; few thin clay films on faces of peds; neutral; clear wavy boundary.

Bt2—4 to 10 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and plastic; many moderately thick clay films on faces of peds; mildly alkaline; clear wavy boundary.

Btk—10 to 14 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, sticky and plastic; few thin clay films on faces of peds; strongly effervescent; common fine irregularly shaped calcium carbonate masses in the form of filaments and threads; moderately alkaline; gradual wavy boundary.

Bk1—14 to 29 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; violently effervescent; few fine soft masses of calcium carbonate; moderately alkaline; gradual wavy boundary.

Bk2—29 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist. It is fine sandy loam, sandy loam, loam, or clay loam.

The Bt horizon has hue of 2.5Y to 10YR, value of 5 or 6 when dry, and and chroma of 3 or 4. Texture is loam or clay loam. The Bt horizon is 24 to 34 percent clay.

The Bk horizon has hue of 2.5Y to 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 or 3.

Cambria Variant

The Cambria Variant consists of deep, well drained, moderately permeable soils in nearly level to undulating areas on toe slopes and alluvial flats. These soils formed in alluvium derived from interbedded shale and sandstone. Slope is 0 to 6 percent.

Typical pedon of a Cambria Variant fine sandy loam in an area of Cambria Variant-Forkwood Variant complex, 0 to 6 percent slopes; 1,150 feet west and 400 feet south of the northeast corner of sec. 27, T. 39 N., R. 71 W.

A—0 to 2 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak fine subangular blocky and granular structure; soft, very friable, nonsticky and nonplastic; neutral; abrupt smooth boundary.

Bw—2 to 5 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt—5 to 9 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate medium and fine subangular blocky structure; hard, friable, sticky and plastic; common moderately thick clay films on faces of peds; neutral; clear smooth boundary.

Bt—9 to 16 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; fine medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; slightly effervescent; few fine soft masses of calcium carbonate; moderately alkaline; clear smooth boundary.

2Bk1—16 to 30 inches; light brownish gray (2.5Y 6/2), stratified clay loam, loam, and fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; strongly effervescent; few fine soft masses of calcium carbonate; moderately alkaline; gradual smooth boundary.

2Bk2—30 to 60 inches; light brownish gray (2.5Y 6/2), stratified loam, sandy clay loam, and sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent; few fine soft masses of calcium carbonate; moderately alkaline.

Depth to carbonates ranges from 8 to 12 inches. Depth to stratified textures ranges from 12 to 24 inches. The profile is 0 to 5 percent coarse fragments.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or

3. Texture is fine sandy loam or sandy loam. Reaction is neutral or mildly alkaline.

The Bt horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or 3. Texture is fine sandy loam or sandy loam. Reaction is neutral or mildly alkaline.

The 2Bk horizon and the C horizon, where present, have hue of 10YR or 2.5Y, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3. Texture varies, but centers on loam or clay loam with thin coarser textured strata. Reaction is mildly alkaline or moderately alkaline.

Clarkelen Series

The Clarkelen series consists of deep, somewhat excessively drained, moderately rapidly permeable soils on flood plains and low stream terraces. These soils formed in stratified Recent alluvium derived from sedimentary rock. Slope is 0 to 3 percent.

Typical pedon of a Clarkelen sandy loam in an area of Clarkelen-Draknab complex, 0 to 3 percent slopes, 2,130 feet north and 285 feet east of the southwest corner of sec. 31., T. 41 N., R. 69 W.

A—0 to 1 inch; pale brown (10YR 6/3) sandy loam, grayish brown (10YR 5/2) moist; weak thin platy structure parting to moderate very fine granular; soft, very friable; slightly effervescent; mildly alkaline; clear smooth boundary.

AC—1 to 3 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; soft, very friable; slightly effervescent; mildly alkaline; clear smooth boundary.

C1—3 to 37 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3), stratified sandy loam, loamy sand, sandy clay loam, and silt loam, grayish brown (10YR 5/2) and brown (10YR 5/3) moist; massive; soft, very friable; slightly effervescent; mildly alkaline; clear smooth boundary.

C2—37 to 60 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grain; loose; slightly effervescent; mildly alkaline.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist. It is sandy loam, loamy sand, or loam.

Cushman Series

The Cushman series consists of moderately deep, well drained, moderately permeable soils on upland ridges, back slopes, and pediment slopes. These soils formed in residuum derived dominantly from calcareous shale and sandstone. Slope is 0 to 15 percent.

Typical pedon of a Cushman loam in an area of Cambria-Cushman complex, 6 to 15 percent slopes, in the SW1/4 of sec. 15, T. 38 N., R. 72 W.

A—0 to 3 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt—3 to 9 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to coarse angular blocky; hard, firm, slightly sticky and slightly plastic; common moderately thick clay films on faces of peds and in pores; neutral; clear smooth boundary.

Btk—9 to 17 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse angular blocky structure parting to moderate medium angular blocky; hard, firm, slightly sticky and slightly plastic; common thin clay films on faces of peds; effervescent; mildly alkaline; gradual wavy boundary.

Bk—17 to 25 inches; pale yellow (2.5Y 7/4) loam, light yellowish brown (2.5Y 6/4) moist; hard, friable, sticky and slightly plastic; strongly effervescent; moderately alkaline, clear smooth boundary.

Crk—25 to 35 inches; calcareous shale; common fine soft masses of calcium carbonate, abrupt smooth boundary.

2Cr—35 inches; calcareous sandstone.

The depth to bedrock ranges from 24 to 35 inches. The depth to calcium carbonate ranges from 9 to 18 inches.

The A horizon has chroma of 2 or 3.

The Bt and Btk horizons have value of 5 or 6 when dry and 4 or 5 when moist. Reaction is neutral to moderately alkaline. The Bk horizon has value of 5 to 7 when dry and 4 to 6 when moist.

Draknab Series

The Draknab series consists of deep, excessively drained, rapidly permeable soils on flood plains. These formed in Recent alluvium derived dominantly from calcareous sedimentary rock. Slope is 0 to 3 percent.

Typical pedon of a Draknab loamy sand in an area of Clarkelen-Draknab complex, 0 to 3 percent slopes, 1,900 feet north and 400 feet east of the southwest corner of sec. 5, T. 40 N., R. 74 W.

A1—0 to 2 inches; yellowish brown (10YR 5/4) loamy sand, brown (10YR 4/3) moist; weak medium and fine granular structure; soft, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; abrupt smooth boundary.

AC—2 to 8 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak medium granular; soft, very friable, nonsticky and nonplastic; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—8 to 18 inches; very pale brown (10YR 7/3) sand, yellowish brown (10YR 5/4) moist; single grain; loose; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.
C2—18 to 26 inches; pale brown (10YR 6/3) loamy coarse sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable; strongly effervescent; moderately alkaline; gradual smooth boundary.
C3—26 to 60 inches; very pale brown (10YR 7/3), stratified coarse sand and loamy sand, pale brown (10YR 6/3) moist; single grain; loose; strongly effervescent; moderately alkaline.

The profile typically is calcareous throughout, but depth to calcium carbonate is as much as 10 inches. Coarse fragment content ranges from 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4. Texture is loam, sandy loam, or loamy sand. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y to 7.5YR. Most pedons are highly stratified. Texture is loamy sand, loamy coarse sand, or sand. Thickness and texture of the strata are highly variable. Reaction is mildly alkaline to strongly alkaline.

Dwyer Series

The Dwyer series consists of deep, excessively drained, rapidly permeable soils on dunes. These soils formed in eolian sand. Slope is 0 to 15 percent.

Typical pedon of a Dwyer loamy sand in an area of Dwyer-Orpha loamy sands, 3 to 15 percent slopes, 50 feet west and 1,050 feet north of the southeast corner of sec. 29, T. 35 N., R. 73 W.

A—0 to 5 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; weak coarse granular structure parting to single grain; soft, loose; strongly effervescent; moderately alkaline; gradual wavy boundary.
AC—5 to 21 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; single grain; soft, loose; strongly effervescent; moderately alkaline; gradual wavy boundary.
C—21 to 60 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; single grain; soft, loose; strongly effervescent; moderately alkaline.

Carbonates commonly are throughout the profile, but in some pedons the carbonates are leached from the A and AC horizons.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 3 or 4. It is loamy sand to fine sand. The C horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4. It is mildly alkaline or moderately alkaline. In some pedons a layer of sandy clay loam, clay loam, loam, or clay is below a depth of 40 inches.

Forkwood Series

The Forkwood series consists of deep, well drained, moderately permeable soils on foot slopes and toe slopes of rolling uplands. These soils formed in local alluvium that is derived from calcareous shale and in some places has a thin mantle of eolian deposits. Slope is 0 to 15 percent.

Typical pedon of a Forkwood fine sandy loam in an area of Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes, 1,050 feet west and 1,600 feet north of the southeast corner of sec. 35, T. 36 N., R. 68 W.

A—0 to 4 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak medium and fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.
BA—4 to 7 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.
Bt—7 to 14 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; strong medium and coarse subangular blocky structure; thin continuous clay films on faces of peds; very hard, firm, sticky and plastic; neutral; clear smooth boundary.
Bk1—14 to 20 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; strongly effervescent; few fine calcium carbonate concretions; mildly alkaline; gradual wavy boundary.
Bk2—20 to 27 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; very hard, friable, sticky and plastic; strongly effervescent; common fine soft masses and filaments of calcium carbonate; mildly alkaline; diffuse wavy boundary.
Bk3—27 to 60 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; massive; very hard, friable, sticky and plastic; strongly effervescent; many medium soft masses of calcium carbonate; mildly alkaline.

The depth to calcium carbonate typically is 12 to 20 inches, but it is as much as 30 inches in some pedons.

The A horizon has hue of 10YR or less; it typically is 2.5Y. It has value of 3 to 5 when moist. Reaction is neutral or mildly alkaline.

The Bt horizon has hue of 10YR or 2.5Y, and it has value of 5 or 6 when dry.

The Bk horizon has hue of 10YR or 2.5Y. It is not present in some pedons that are deeply leached.

Forkwood Variant

The Forkwood Variant consists of deep, well drained, moderately slowly permeable soils in nearly level to undulating areas on toe slopes and alluvial flats. These soils formed in alluvium derived from shale with some interbedded sandstone. Slope is 0 to 6 percent.

Typical pedon of a Forkwood Variant clay loam in an area of Cambria Variant-Forkwood Variant complex, 0 to 6 percent slopes, 1,400 feet north and 1,100 feet west of the southeast corner of sec. 21, T. 39 N., R. 71 W.

A—0 to 3 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; neutral; abrupt smooth boundary.

Bt1—3 to 9 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common thin clay films on faces of peds; neutral; clear smooth boundary.

Bt2—9 to 16 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common thin clay films on faces of peds; neutral; clear smooth boundary.

2Bk1—16 to 30 inches; light gray (2.5Y 7/2), stratified loam, clay loam, and fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and plastic; few fine soft masses of calcium carbonate and concretions of calcium carbonate in a noncalcareous matrix; mildly alkaline; gradual smooth boundary.

2Bk2—30 to 60 inches; light gray (10YR 7/2), stratified clay loam and loam, grayish brown (10YR 5/2) moist; massive; hard, firm, sticky and plastic; slightly effervescent; few fine soft masses of calcium carbonate and concretions of calcium carbonate; moderately alkaline.

Depth to carbonates and stratified material ranges from 12 to 24 inches. Coarse fragments typically are absent, but where present they make up as much as 5 percent of the profile.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 to 6 when moist, and chroma of 2 or 3. Texture is loam or clay loam. Reaction is neutral or mildly alkaline.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. Texture is clay loam or heavy loam. Reaction is neutral or mildly alkaline.

The 2Bk horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3. Texture is stratified clay loam to fine sandy loam. Reaction is mildly alkaline or moderately alkaline.

Gateson Variant

The Gateson Variant consists of shallow, well drained, moderately permeable soils on upland shoulder slopes and back slopes. These soils formed in residuum derived dominantly from noncalcareous sandstone. Slope is 10 to 45 percent.

Typical pedon of a Gateson Variant loamy sand in an area of Gateson Variant-Tassel Variant association, 10 to 45 percent slopes, in the NE1/4NE1/4SW1/4 of sec. 12, T. 40 N., R. 77 W.

Oi—1 inch to 0; forest litter consisting largely of undecomposed pine needles.

E—0 to 4 inches; pinkish gray (7.5YR 7/2) loamy sand, pinkish gray (7.5YR 6/2) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; neutral; clear smooth boundary.

Bt—4 to 11 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and plastic; common thin yellowish red (5YR 5/6) clay films on faces of peds; mildly alkaline; clear smooth boundary.

2C—11 to 16 inches; pinkish gray (5YR 7/2) clay, reddish brown (5YR 5/3) moist; massive; hard, firm, sticky and plastic; about 15 percent shale chips and sandstone channery fragments; mildly alkaline; gradual smooth boundary.

3Cr—16 inches; soft interbedded noncalcareous fractured sandstone and shale flagstones.

Depth to rock and thickness of the solum range from 15 to 24 inches. Coarse fragment content typically is less than 15 percent.

The Bt horizon typically is 18 to 35 percent clay, but in a few pedons it is as little as 15 percent clay. In some pedons there is a BK or CK horizon.

Haverdad Series

The Haverdad series consists of deep, well drained, moderately permeable soils on flood plains and low terraces. These soils formed in stratified Recent alluvium derived from sedimentary rock. Slope is 0 to 6 percent.

Typical pedon of a Haverdad fine sandy loam in an area of Haverdad-Lohmiller complex, 0 to 6 percent slopes, 1,300 feet east and 130 feet south of the northwest corner of sec. 31., T. 40 N., R. 68 W.

A—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist;

moderate medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; abrupt smooth boundary.

C1—6 to 10 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C2—10 to 60 inches; light brownish gray (10YR 6/2) loam stratified with sandy loam, clay loam, and loamy sand, grayish brown (10YR 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline.

The profile typically is leached in the A horizon, but some pedons are calcareous throughout.

The A horizon has chroma of 2 or 3. It is fine sandy loam, loam, silt loam, or sandy loam. Reaction is mildly alkaline or moderately alkaline.

The control section is clay loam, loam, or very fine sandy loam.

Heldt Series

The Heldt series consists of deep, well drained, slowly permeable soils on toe slopes and alluvial flats. These soils formed in local alluvium derived dominantly from calcareous shale. Slope is 0 to 6 percent.

Typical pedon of a Heldt clay loam in an area of Silhouette-Heldt association, 0 to 6 percent slopes; 1,200 feet east and 75 feet south of the northwest corner of sec. 15, T. 38 N., R. 71 W.

E—0 to 1 inch; light gray (10YR 7/2) clay loam, brown (10YR 5/3) moist; vesicular crust; massive; slightly hard, friable, sticky and plastic; slightly effervescent; neutral; abrupt smooth boundary.

AB—1 to 8 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak fine subangular blocky and granular structure; hard, firm, sticky and plastic; slightly effervescent; mildly alkaline; clear smooth boundary.

Bw1—8 to 15 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak medium and fine subangular blocky structure; very hard, very firm, sticky and plastic; slightly effervescent; mildly alkaline; gradual smooth boundary.

Bw2—15 to 26 inches; light gray (10YR 7/2) clay, pale brown (10YR 6/3) moist; weak medium angular blocky structure; very hard, very firm, sticky and plastic; slightly effervescent; mildly alkaline; gradual smooth boundary.

C—26 to 35 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; very hard, very firm, sticky and plastic; common distinct pressure faces at an angle of about 20 degrees from vertical; slightly effervescent; mildly alkaline; gradual smooth boundary.

Ck—35 to 60 inches; very pale brown (10YR 7/3) clay, yellowish brown (10YR 5/4) moist; massive; very hard, very firm, sticky and plastic; slightly effervescent; common medium seams and filaments of calcium carbonate; mildly alkaline.

Electrical conductivity typically is less than 4 millimhos per centimeter, and cation exchange capacity per 100 grams of clay ranges from 90 to 100.

The E horizon has hue of 10YR or 2.5Y and chroma of 2 or 3.

The Bw horizon has hue of 10YR or 2.5Y and chroma of 2 or 3.

The Ck horizon has hue of 10YR or 2.5Y. It is mildly alkaline or moderately alkaline.

Hiland Series

The Hiland series consists of deep, well drained, moderately permeable soils on back slopes of rolling uplands and adjacent foot slopes. These soils formed in residuum and local alluvium derived from soft calcareous sandstone and in eolian material. Slope is 0 to 15 percent.

Typical pedon of a Hiland sandy clay loam in an area of Hiland-Bowbac complex, 6 to 15 percent slopes, 3,000 feet west and 600 feet south of the northeast corner of sec. 26, T. 35 N., R. 75 W.

A—0 to 3 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; neutral; clear wavy boundary.

BA—3 to 10 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Bt—10 to 19 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; strong very coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, sticky and plastic; many moderately thick clay bridges between sand grains; mildly alkaline; clear smooth boundary.

Btk—19 to 24 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; many moderately thick clay bridges between sand grains; strongly effervescent; common fine irregularly shaped calcium carbonate filaments and threads; moderately alkaline; gradual wavy boundary.

Bk1—24 to 36 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard,

friable, sticky and plastic; strongly effervescent; common fine calcium carbonate filaments; moderately alkaline; gradual wavy boundary.
Bk2—36 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, sticky and plastic; strongly effervescent; common fine irregularly shaped calcium carbonate filaments and threads; moderately alkaline.

The depth to calcium carbonate ranges from 15 to 30 inches.

The A horizon is sandy loam or sandy clay loam.

The Bt horizon has hue of 2.5Y to 10YR, and it has value of 5 or 6 when dry and 4 or 5 when moist. Clay content averages 24 to 34 percent. Reaction is neutral to moderately alkaline. The Bk horizon has hue of 2.5Y to 10YR, and it has value of 4 or 5 when moist. Reaction is mildly alkaline or moderately alkaline.

Keeline Series

The Keeline series consists of deep, somewhat excessively drained, moderately rapidly permeable soils on ridges and sides slopes of rolling uplands. These soils formed in wind-worked residuum derived dominantly from calcareous sandstone. Slope is 6 to 15 percent.

Typical pedon of a Keeline sandy loam in an area of Keeline-Tassel-Turnback complex, 6 to 15 percent slopes; 2,100 feet north and 400 feet west of the southeast corner of sec. 29, T. 40 N., R. 75 W.

A—0 to 3 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky and granular structure; soft, very friable, nonsticky and nonplastic; slightly effervescent; mildly alkaline; abrupt smooth boundary.
Bw—3 to 8 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent; calcium carbonate disseminated throughout matrix; mildly alkaline; clear smooth boundary.
C1—8 to 17 inches; very pale brown (10YR 7/3) sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated throughout matrix; moderately alkaline; gradual smooth boundary.
C2—17 to 30 inches; very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated throughout matrix; moderately alkaline; gradual smooth boundary.
C3—30 to 60 inches; very pale brown (10YR 7/3) sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated throughout matrix; moderately alkaline.

The profile is calcareous throughout in most pedons, but in some pedons the upper few inches is leached.

The A horizon has hue of 7.5YR or 10YR and chroma of 3 or 4. Reaction is mildly alkaline or neutral.

The C horizon has hue of 7.5YR to 2.5Y. Reaction is moderately alkaline or strongly alkaline.

Kishona Series

Kishona series consists of deep, well drained, moderately permeable soils on upland hill slopes and on adjacent toe slopes, foot slopes, and alluvial flats and fans. These soils formed in calcareous local alluvium derived dominantly from sedimentary rock. Slope is 0 to 15 percent.

Typical pedon of a Kishona loam in an area of Theedle-Kishona association, 6 to 15 percent slopes; 2,600 feet east and 50 feet north of the southwest corner of sec. 35, T. 38 N., R. 75 W.

A—0 to 3 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak fine and medium granular structure; soft, friable, slightly sticky and slightly plastic; violently effervescent; moderately alkaline; abrupt smooth boundary.
AC—3 to 12 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; violently effervescent; moderately alkaline; clear smooth boundary.
C1—12 to 36 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; violently effervescent; few fine soft masses of calcium carbonate; moderately alkaline; gradual smooth boundary.
C2—36 to 60 inches; light gray (2.5Y 7/2) clay loam, light yellowish brown (2.5Y 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; violently effervescent; few fine soft masses of calcium carbonate; moderately alkaline.

The A horizon is loam or light clay loam.

The C horizon has hue of 10YR or 2.5Y. Reaction is moderately alkaline or strongly alkaline.

Lohmiller Series

The Lohmiller series consists of deep, well drained, moderately slowly permeable soils on narrow flood plains. These soils formed in stratified Recent alluvium derived from sedimentary rock. Slope is 0 to 6 percent.

Typical pedon of a Lohmiller clay loam in an area of Haverdad-Lohmiller complex, 0 to 6 percent slopes,

1,980 feet south and 1,580 feet west of the northeast corner of sec. 35, T. 37 N., R. 73 W.

A—0 to 3 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; slightly effervescent; mildly alkaline; clear smooth boundary.
AC—3 to 16 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium and fine subangular blocky structure; hard, very firm, sticky and plastic; slightly effervescent; mildly alkaline; clear smooth boundary.
C1—16 to 19 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, friable, slightly sticky and nonplastic; slightly effervescent; moderately alkaline; clear wavy boundary.
C2—19 to 60 inches; light yellowish brown (2.5Y 6/4) and brown (10YR 5/3), stratified sandy clay loam, sandy loam, and sandy clay, light olive brown (2.5Y 5/4) and brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and plastic; slightly effervescent; moderately alkaline.

The profile commonly is calcareous throughout, but in some pedons the upper few inches is leached.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. Reaction is mildly alkaline to strongly alkaline.

The C horizon has hue of 2.5Y or 10YR. Reaction is moderately alkaline or strongly alkaline. The control section is heavy clay loam or silty clay.

Orella Series

The Orella series consists of shallow, well drained, slowly permeable soils on back slopes and ridgetops of uplands. These soils formed in residuum derived from sodic shale. Slope is 3 to 25 percent.

Typical pedon of an Orella clay loam in an area of Orella-Rock outcrop-Samday complex, 3 to 30 percent slopes, 1,800 feet north and 1,200 feet west of the southeast corner of sec. 2, T. 40 N., R. 71 W.

A—0 to 4 inches; light gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; few medium and fine roots; slightly effervescent; moderately alkaline; clear smooth boundary.
ACk—4 to 13 inches; light gray (2.5Y 7/2) light clay, light brownish gray (2.5Y 6/2) moist; moderate fine angular blocky structure; hard, firm, sticky and plastic; few fine roots; content of shale fragments increases with increasing depth; strongly effervescent; common medium seams of calcium carbonate; moderately alkaline; gradual smooth boundary.
Ck—13 to 20 inches; light brownish gray (2.5Y 6/2) clay between weathered shale fragments, grayish brown (2.5Y 5.2) moist; common medium yellowish red (5YR 5/6) oxide stains on shale fragments; massive; hard, firm, very sticky and very plastic; few fine and very fine roots; noneffervescent; few medium and fine calcium carbonate concretions; moderately alkaline; gradual smooth boundary.
Cr—20 to 60 inches; light gray (2.5Y 7/2) shale, grayish brown (2.5Y 5.2) moist; common medium and fine olive yellow (2.5Y 6/8) and brownish yellow (10YR 6/8) oxides and oxide stains; noneffervescent.

The depth to shale ranges from 10 to 20 inches. The profile commonly is calcareous throughout, but in some pedons it is leached to a depth of as much as 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3. It is typically clay loam or clay.

The Ck horizon has hue of 2.5Y or 10YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3. It is clay or heavy clay loam.

Orpha Series

The Orpha series consists of deep, excessively drained, very rapidly permeable soils on dunes. These soils formed in eolian sand. Slope is 0 to 15 percent.

Typical pedon of an Orpha loamy sand in an area of Dwyer-Orpha loamy sands, 3 to 15 percent slopes, 200 feet west and 1,250 feet south of the northeast corner of sec. 31, T. 41 N., R. 67 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak moderate and coarse granular structure parting to single grain; loose; mildly alkaline; gradual wavy boundary.
C—6 to 60 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grain; loose; mildly alkaline.

Depth to calcium carbonate ranges from 40 to 60 inches or more.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 or 3. It is loamy sand or sand.

The C horizon has value of 6 or 7 when dry and 5 or 6 when moist, and it has chroma of 2 to 4. Clay content ranges from 3 to 10 percent. Reaction is neutral or mildly alkaline.

Renohill Series

The Renohill series consists of moderately deep, well drained, slowly permeable soils on upland ridgetops,

back slopes, and foot slopes. These soils formed in residuum derived from soft shale. Slope is 0 to 15 percent.

Typical pedon of a Renohill fine sandy loam in an area of Ulm-Renohill complex, 0 to 6 percent slopes, 2,640 feet south of the northeast corner of sec. 31, T. 38 N., R. 68 W.

A—0 to 5 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt—5 to 20 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to coarse subangular blocky; very hard, very firm, sticky and plastic; common moderately thick clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Bk—20 to 36 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; slightly effervescent; few fine soft white filaments and threads of carbonates; moderately alkaline.

Cr—36 inches; calcareous shale.

The depth to bedrock ranges from 20 to 40 inches. The depth to calcium carbonate ranges from 10 to 20 inches.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 or 3. It is fine sandy loam or clay loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is clay or clay loam and averages 37 to 46 percent clay. Reaction is neutral to moderately alkaline.

The Bk horizon has value of 6 or 7 when dry and chroma of 2 to 4. It is moderately alkaline or strongly alkaline.

The Cr horizon is calcareous shale or sandstone.

Samday Series

The Samday series consists of shallow, well drained, very slowly permeable soils on summits, shoulder slopes, and ridges of upland hills and on scarps where the shale beds have been exposed by geologic erosion. These soils formed in residuum derived from soft calcareous shale. Slope is 3 to 30 percent.

Typical pedon of a Samday clay loam in an area of Samday-Shingle-Worf complex, 3 to 15 percent slopes, 2,500 feet north and 1,600 feet west of the southeast corner of sec. 36, T. 37 N., R. 69 W.

A—0 to 2 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate coarse platy structure parting to weak fine granular; slightly hard, friable, sticky and plastic; effervescent; disseminated carbonates; moderately alkaline; gradual wavy boundary.

C—2 to 10 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; strong coarse subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; strongly effervescent; disseminated carbonates; moderately alkaline; gradual wavy boundary.

Cky—10 to 18 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; hard, firm, sticky and plastic; strongly effervescent; gypsum crystals and many fine soft filaments and threads of carbonates and gypsum crystals; about 20 percent soft weathered shale chips; moderately alkaline, clear wavy boundary.

Cr—18 inches; calcareous shale and sandstone.

The A horizon has value of 6 or 7 when dry and 5 or 6 when moist. It is clay loam or clay.

The AC horizon has value of 6 or 7 when dry and 5 or 6 when moist, and it has chroma of 2 or 3. Reaction is moderately alkaline or strongly alkaline.

The Cky horizon has value of 5 or 6 when moist. Reaction is neutral to moderately alkaline.

The Cr horizon is calcareous shale or sandstone.

Savageton Series

The Savageton series consists of moderately deep, well drained, slowly permeable soils on toe slopes and alluvial flats. These soils formed in residuum or local alluvium derived from calcareous shale. Slope is 0 to 6 percent.

Typical pedon of a Savageton clay loam in an area of Bahl-Savageton complex, 0 to 6 percent slopes, 400 feet north and 750 feet west of the southeast corner of sec. 31, T. 37 N., R. 68 W.

A—0 to 2 inches; gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; moderate medium platy structure and moderate medium granular; slightly hard, friable, sticky and plastic, mildly alkaline; clear wavy boundary.

Bw—2 to 22 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure that parts to moderate medium subangular blocky; hard, firm, sticky and plastic; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bk1—22 to 28 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate coarse subangular blocky structure parting to fine subangular blocky; hard, firm, sticky and plastic; many moderately thick clay films on faces of peds; strongly effervescent; common fine irregularly

shaped filaments or threads of calcium carbonate; moderately alkaline; clear smooth boundary.
Bk2—28 to 32 inches; grayish brown (10YR 5/2) clay, dark brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; strongly effervescent; common fine irregularly shaped filaments or threads of calcium carbonate; moderately alkaline; abrupt wavy boundary.
Cr—32 inches; calcareous platy shale.

The depth to calcium carbonate ranges from 10 to 22 inches. Depth to bedrock ranges from 32 to 39 inches.

The A horizon has value of 4 to 6 when dry and chroma of 1 or 2.

The Bw horizon has value of 5 or 6 when dry. It averages 35 to 40 percent clay.

Sear Series

The Sear series consists of very shallow, well drained, moderately permeable soils on hill slopes and on the summit of buttes. These soils formed in residuum derived from porcellanite. Slope is 0 to 15 percent.

Typical pedon of a Sear loam in an area of Sear-Wibaux complex, 0 to 15 percent slopes, 1,825 feet north and 1,650 feet west of the southeast corner of sec. 2, T. 40 N., R. 71 W.

A—0 to 2 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots and few medium roots; about 15 percent reddish yellow (5YR 6/8) and red (2.5YR 6/8) porcellanite fragments 0.25 to 1.0 inch in diameter; neutral; clear smooth boundary.
Bt—2 to 9 inches; brown (7.5YR 5/4) channery loam, dark brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and slightly plastic; few thin clay films on faces of peds; common fine and very fine roots; about 30 percent red (2.5YR 6/8) and brown (7.5YR 5/4) porcellanite fragments 0.25 inch to 2.0 inches in diameter; neutral; clear irregular boundary.
Bk1—9 to 35 inches; red (2.5YR 6/8) and reddish yellow (5YR 6/8) porcellanite fragments 0.5 inch to 4.0 inches in diameter; light brown (7.5YR 6/4) loam fills voids in upper part of horizon and decreases to a trace in lower part; calcium carbonate coating on undersides of larger fragments; diffuse wavy boundary.
Bk2—35 to 60 inches; red (2.5YR 5/6 and 5/8) porcellanite fragments 1 inch to 4 inches in diameter; traces of red (2.5YR 5/6) sandy loam in vertical and horizontal fractures in upper part.

Depth to calcium carbonate ranges mainly from 5 to 10 inches, but it is as much as 20 inches in some pedons. Fragmented porcellanite makes up 90 percent or more of all horizons below a depth of 10 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. Reaction is neutral or mildly alkaline.

The Bt horizon has hue of 5YR to 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is clay loam or loam and is 10 to 35 percent porcellanite fragments. Reaction is neutral to moderately alkaline.

The Bk horizon has traces of soil material between porcellanite fragments.

Shingle Series

The Shingle series consists of shallow, well drained, moderately permeable soils on ridgetops, shoulder slopes, and back slopes of uplands and on scarps in areas where the shale beds have been exposed by geologic erosion. These soils formed in residuum derived from soft calcareous shale. Slope is 3 to 45 percent.

Typical pedon of a Shingle clay loam in an area of Worf-Shingle-Tassel complex, 3 to 30 percent slopes, 1,320 feet west and 550 feet north of the southeast corner of sec. 30, T. 40 N., R. 68 W.

A—0 to 4 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate very thin and thin platy structure parting to moderate very fine and fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly effervescent; disseminated carbonates; moderately alkaline; clear wavy boundary.
C—4 to 18 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; strongly effervescent; disseminated carbonates; about 15 percent shale fragments; strongly alkaline, clear wavy boundary.
Cr—18 inches; calcareous shale.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is clay loam, very fine sandy loam, loam, or sandy clay loam.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4. It is mildly alkaline to strongly alkaline.

Silhouette Series

The Silhouette series consists of deep, well drained, slowly permeable soils on foot slopes and alluvial flats. These soils formed in local alluvium derived dominantly from calcareous shale. Slope is 0 to 6 percent.

Typical pedon of a Silhouette clay loam in an area of Silhouette-Heldt association, 0 to 6 percent slopes, 150

feet west and 600 feet south of the northeast corner of sec. 20, T. 39 N., R. 71 W.

A—0 to 2 inches; light brownish gray (10YR 6/2) clay loam, brown (10YR 5/3) moist; weak medium and fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; slightly effervescent; mildly alkaline; abrupt smooth boundary.
BA—2 to 6 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; slightly effervescent; moderately alkaline; clear smooth boundary.
Bw1—6 to 14 inches; pale brown (10YR 6/3) clay, grayish brown (10YR 5/2) moist; weak fine prismatic structure; hard, friable, sticky and plastic; slightly effervescent; moderately alkaline; clear smooth boundary.
Bw2—14 to 22 inches; pale brown (10YR 6/3) clay, grayish brown (10YR 5/2) moist; weak fine angular blocky structure; very hard, firm, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline; gradual smooth boundary.
Bk1—22 to 34 inches; very pale brown (10YR 7/3) clay, light brownish gray (10YR 6/2) moist; massive; very hard, firm, slightly sticky and slightly plastic; slightly effervescent; common medium seams and filaments of calcium carbonate; moderately alkaline; gradual smooth boundary.
Bk2—34 to 60 inches; light gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; massive; very hard, very firm, slightly sticky and slightly plastic; slightly effervescent; few medium soft calcium carbonate masses and iron concretions; mildly alkaline.

Electrical conductivity typically is less than 4 millimhos per centimeter, and cation exchange capacity per 100 grams of clay ranges from 80 to 90.

Tassel Series

The Tassel series consists of shallow, well drained, moderately rapidly permeable soils on shoulder slopes and ridgetops of uplands. These soils formed in residuum derived from soft calcareous sandstone. Slope is 3 to 30 percent.

Typical pedon of a Tassel loamy fine sand in an area of Tassel-Tullock-Vonalee association, 6 to 30 percent slopes, 1,950 feet east and 375 feet south of the northwest corner of sec. 8, T. 40 N., R. 68 W.

A—0 to 2 inches; light brownish gray (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak medium and coarse granular structure; soft, very friable, nonsticky and nonplastic; slightly effervescent; disseminated carbonates; mildly alkaline; gradual wavy boundary.
AC—2 to 5 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak medium and coarse granular structure; soft, very friable, nonsticky and nonplastic; slightly effervescent; disseminated carbonates; mildly alkaline; gradual wavy boundary.
C—5 to 16 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak very fine and fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine pores; slightly effervescent; disseminated carbonates; mildly alkaline, clear wavy boundary.
Cr—16 inches; soft, calcareous, light gray (5Y 7/1) sandstone.

The profile is neutral to moderately alkaline. It commonly has calcium carbonate throughout, but in a few areas it is noncalcareous.

The A horizon is loamy fine sand, loamy sand, sandy loam, or fine sandy loam.

The C horizon has chroma of 3 or 4. The control section is fine sandy loam or sandy loam.

Tassel Variant

The Tassel Variant consists of very shallow, well drained, moderately rapidly permeable soils on ridges of rolling and hilly uplands. These soils formed in residuum derived from calcareous sandstone interbedded with shale. Slope is 10 to 30 percent.

Typical pedon of a Tassel Variant very fine sandy loam in an area of Gateson Variant-Tassel Variant association, 10 to 45 percent slopes, in the S1/4 of sec. 11, T. 40 N., R. 77 W.

A—0 to 4 inches; light yellowish brown (10YR 6/4) very fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; strongly effervescent; mildly alkaline; clear smooth boundary.
Ck—4 to 9 inches; gray (5YR 5/1) loam, dark gray (5YR 4/1) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent; few fine soft masses and filaments of calcium carbonate; moderately alkaline; gradual wavy boundary.
Cr—9 inches; interbedded sedimentary rock, dominantly shale.

Depth to soft sedimentary rock ranges from 5 to 10 inches. Content of coarse fragments does not normally exceed 5 percent, but in some areas as much as 10 percent of the surface is covered with ironstone flagstones.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. Texture is fine sandy loam or very fine sandy loam. Reaction is neutral or mildly alkaline.

The Ck horizon has hue of 5YR to 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 1 to 3. Texture is loam or sandy loam. Reaction is mildly alkaline or moderately alkaline.

Terro Series

The Terro series consists of moderately deep, somewhat excessively drained, moderately rapidly permeable soils on ridges, hill slopes, and pediment slopes of uplands. These soils formed in residuum derived from soft calcareous sandstone. Slope is 0 to 30 percent.

Typical pedon of a Terro sandy loam (fig. 4) in an area of Vonalee-Terro complex, 0 to 15 percent slopes, 1,000 feet west and 1,250 feet south of the northeast corner of sec. 17, T. 31 N., R. 74 W.

A—0 to 4 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium and fine granular structure; loose, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt1—4 to 10 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic, clear smooth boundary.

Bt2—10 to 23 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common thin clay bridges between sand grains; mildly alkaline; clear smooth boundary.

Bk—23 to 34 inches; light gray (10YR 7/2) sandy loam, light brownish gray (10YR 6/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; violently effervescent; many fine irregularly shaped soft masses of calcium carbonate; moderately alkaline; clear irregular boundary.

Cr—34 inches; white (10YR 8/2) calcareous coarse-grained soft sandstone.

The depth to continuous carbonates ranges from 15 to 30 inches. Depth to bedrock ranges from 26 to 39 inches.

The A horizon has value of 5 or 6 when dry and chroma of 2 or 3. It is sandy loam or fine sandy loam.

The Bt horizon has value of 5 or 6 when dry and chroma of 3 or 4. Reaction is neutral to moderately alkaline.

The Bk horizon has value of 6 or 7 when dry and 5 or 6 when moist, and it has chroma of 2 to 4. It is neutral to moderately alkaline.

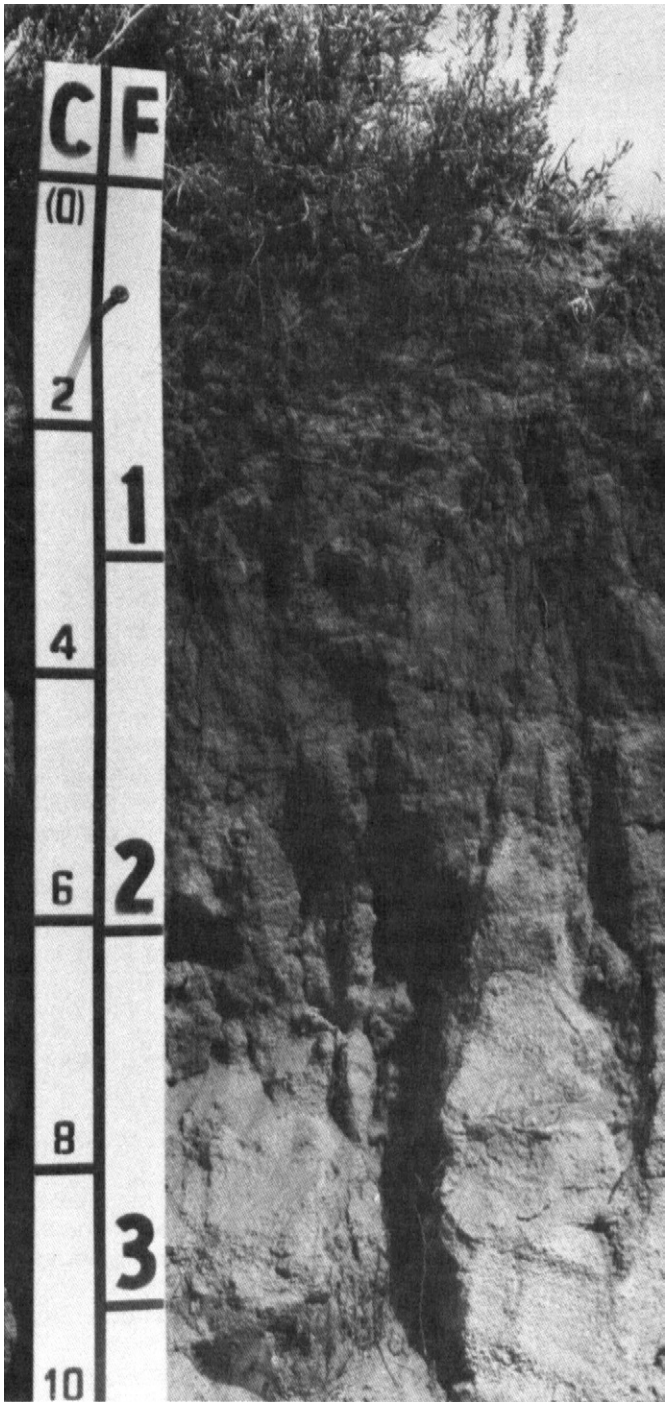


Figure 4.—Profile of Terro sandy loam. Soft sandstone is at depth of 2 feet; some roots have penetrated to depths of 3 feet in softer soils.

Theedle Series

The Theedle series consists of moderately deep, well drained, moderately permeable soils on ridges, hill slopes, and pediment slopes of uplands and on alluvial fans and foot slopes adjacent to major and minor drainageways. These soils formed in residuum derived from calcareous shale. Slope is 0 to 30 percent.

Typical pedon of a Theedle loam in an area of Zigweid-Cambria-Theedle association, 6 to 15 percent slopes, 1,580 feet south and 10 feet west of the northeast corner of sec. 19, T. 35 N., R. 67 W.

A—0 to 2 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent; calcium carbonate disseminated throughout matrix; mildly alkaline; clear wavy boundary.

AC—2 to 5 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; strongly effervescent; calcium carbonate disseminated throughout matrix; mildly alkaline; gradual wavy boundary.

Ck—5 to 20 inches; light gray (10YR 7/2) loam, very pale brown (10YR 7/4) moist; massive; hard, friable, slightly sticky and slightly plastic; strongly effervescent; common fine masses and seams of calcium carbonate; moderately alkaline; gradual wavy boundary.

Ck2—20 to 28 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; very hard, friable, sticky and plastic; strongly effervescent; few fine soft masses and seams of calcium carbonate; strongly alkaline; clear wavy boundary.

Crk—28 to 48 inches; gray (10YR 5/1) clay shale changing with depth to light gray (10YR 6/1) noncalcareous; common medium seams and filaments of calcium carbonate that decrease in number and size as depth increases.

The C horizon has hue of 10YR to 5Y and value of 5 or 6 when moist. Reaction is moderately alkaline or strongly alkaline. Texture is loam or light clay loam.

Tullock Series

The Tullock series consists of moderately deep, excessively drained, rapidly permeable soils on shoulder slopes, back slopes, and ridges of upland hills. These soils formed in residuum derived from calcareous sandstone. Slope is 0 to 30 percent.

Typical pedon of a Tullock loamy sand in an area of Tassel-Tullock-Vonalee association, 6 to 30 percent slopes, 1,200 feet west and 1,000 feet north of the southeast corner of sec. 29, T. 35 N., R. 73 W.

A—0 to 5 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; weak medium and fine crumb structure; soft, loose; slightly effervescent; disseminated calcium carbonate; mildly alkaline; clear wavy boundary.

AC—5 to 20 inches; brown (10YR 5/3) sand, dark brown (10YR 4/3) moist; massive; soft, loose; strongly effervescent; disseminated calcium carbonate; mildly alkaline; clear wavy boundary.

C—20 to 31 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; soft, loose; strongly effervescent; disseminated calcium carbonate; mildly alkaline; clear wavy boundary.

Cr—31 inches; soft calcareous sandstone.

The depth to bedrock ranges from 24 to 36 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. Reaction is mildly alkaline or moderately alkaline.

The AC horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is loamy sand, fine sand, loamy fine sand, or fine sandy loam. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 to 4. Reaction is mildly alkaline or moderately alkaline.

The Cr horizon is dominantly soft calcareous sandstone, but in some pedons it is interbedded with seams of calcareous shale.

Turnback Series

The Turnback series consists of moderately deep, well drained, moderately rapidly permeable soils on upland ridgetops and shoulders. These soils formed in wind-worked residuum derived from calcareous sandstone. Slope is 6 to 15 percent.

Typical pedon of a Turnback loamy fine sand in an area of Keeline-Tassel-Turnback complex, 6 to 15 percent slopes, 2,500 feet east and 1,900 feet north of the southwest corner of sec. 19, T. 39 N., R. 74 W.

A—0 to 4 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; weak fine granular structure; loose, nonsticky and nonplastic; few fine calcium carbonate seams; moderately alkaline; clear smooth boundary.

Bw1—4 to 8 inches; pale brown (10YR 6/3) sandy loam, yellowish brown (10YR 5/4) moist; weak medium and fine subangular blocky structure; loose, nonsticky and nonplastic; violently effervescent; few fine calcium carbonate seams; moderately alkaline; clear smooth boundary.

Bw2—8 to 20 inches; light yellowish brown (2.5Y 6/4) sandy loam, light olive brown (2.5Y 5/4) moist; weak medium subangular blocky structure; soft, very

friable, slightly sticky and slightly plastic; strongly effervescent; common medium and fine calcium carbonate seams; moderately alkaline; clear wavy boundary.

Bk1—20 to 30 inches; pale yellow (2.5Y 7/4) sandy loam, light olive brown (2.5Y 5/4) moist; massive with some inherited rock structural planes; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; few medium and coarse soft masses of calcium carbonate and few fine calcium carbonate seams; moderately alkaline; gradual wavy boundary.

Cr—30 inches; yellow (10YR 7/8) soft calcareous sandstone; moderately alkaline; very slightly effervescent.

The profile commonly is leached in the upper few inches, but in some pedons it is calcareous throughout. Coarse fragment content is typically less than 5 percent.

Ulm Series

The Ulm series consists of deep, well drained, moderately permeable to slowly permeable soils on alluvial flats and toe slopes and on foot slopes of rolling uplands. These soils formed in local alluvium derived from soft calcareous shale. Slope is 0 to 15 percent.

Typical pedon of an Ulm loam in an area of Ulm-Bidman complex, 0 to 6 percent slopes, 751 feet west and 203 feet north of the southeast corner of sec. 32, T. 35 N., R. 70 W.

A—0 to 5 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

Bt1—5 to 9 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, sticky and plastic; few thin clay bridges between mineral grains; neutral; clear wavy boundary.

Bt2—9 to 21 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong fine and medium prismatic structure parting to strong fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; many moderately thick clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Bk1—21 to 36 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, sticky and plastic; strongly effervescent; common medium masses of carbonates; moderately alkaline; clear wavy boundary.

Bk2—36 to 60 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, sticky and plastic; violently effervescent; common fine masses of carbonates; moderately alkaline.

The depth to calcium carbonate ranges from 15 to 28 inches.

The A horizon has value of 4 to 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3. It is loam or clay loam.

The Bt horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4. Texture is clay, clay loam, or sandy clay that averages 37 to 45 percent clay. Reaction is neutral or mildly alkaline.

The Bk horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 4. Texture is clay loam, fine sandy loam, sandy loam, loam, or sandy clay loam. Reaction is moderately alkaline or strongly alkaline.

Ustic Torriorthents

Ustic Torriorthents are mainly deep, well drained soils of variable permeability around coal and uranium strip mines and porcellanite borrow areas. These soils formed in recently reclaimed overburden from mining operations. Slope is 3 to 30 percent.

Reference pedon of Ustic Torriorthents, reclaimed, 3 to 30 percent slopes, 800 feet south and 250 feet west of the northeast corner of sec. 10, T. 35 N., R. 75 W.

A—0 to 5 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; moderately acid; clear wavy boundary.

C1—5 to 9 inches; light gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) moist; massive; loose, very friable, nonsticky and nonplastic; extremely acid; gradual broken boundary.

C2—9 to 15 inches; reddish yellow (7.5YR 6/8) loamy sand, strong brown (7.5YR 6.8) moist; massive; loose, very friable, nonsticky and nonplastic; extremely acid; gradual broken boundary.

C3—15 to 20 inches; light brownish gray (10YR 6/2) loamy sand, grayish brown (10YR 5/2) moist; massive; loose, very friable, nonsticky and nonplastic; about 10 percent fine coal fragments; extremely acid; gradual broken boundary.

C4—20 to 60 inches; light gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) moist; massive; loose, very friable, nonsticky and nonplastic; very strongly acid.

Reaction ranges from extremely acid to moderately alkaline. The control section is loamy sand to clay loam.

Thin seams of mostly shale or coal fragments are present in some pedons.

Vonalee Series

The Vonalee series consists of deep, somewhat excessively drained, rapidly permeable soils in undulating to rolling areas on uplands and high terraces. These soils formed in eolian sand and wind-reworked sandstone residuum. Slope is 0 to 15 percent.

Typical pedon of a Vonalee loamy sand in an area of Vonalee-Terro complex, 6 to 15 percent slopes, 100 feet west and 1,600 feet north of southeast corner of sec. 29, T. 35 N., R. 73 W.

A—0 to 4 inches; yellowish brown (10YR 5/4) loamy sand, dark yellowish brown (10YR 4/4) moist; moderate thin platy structure parting to weak fine granular; soft, loose, nonsticky and nonplastic; neutral; gradual wavy boundary.

BA—4 to 10 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; neutral; gradual wavy boundary.

Bt1—10 to 17 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few thin clay bridges between sand grains; mildly alkaline; gradual wavy boundary.

Bt2—17 to 24 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few thin clay bridges between sand grains; moderately alkaline; clear wavy boundary.

Bk1—24 to 44 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; moderate coarse prismatic structure; soft, loose, nonsticky and nonplastic; slightly effervescent; mildly alkaline; clear wavy boundary.

Bk2—44 to 60 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, sticky and plastic; violently effervescent; many fine and medium irregularly shaped threads and filaments of calcium carbonate; moderately alkaline.

Wibaux Series

The Wibaux series consists of shallow, somewhat excessively drained, moderately permeable soils on hill slopes, buttes, and ridge crests of uplands. These soils formed in residuum derived from porcellanite. Slope is 0 to 45 percent.

Typical pedon of a Wibaux channery loam in an area of Sear-Wibaux complex, 0 to 15 percent slopes, 1,450 feet west and 1,300 feet south of the northeast corner of sec. 2, T. 40 N., R. 71 W.

A—0 to 4 inches; pinkish gray (7.5YR 6/2) channery loam, brown (7.5YR 5/4) moist; weak fine granular structure; soft, friable; about 35 percent red (2.5YR 4/8) porcellanite fragments 0.5 inch to 1.5 inches in diameter; mildly alkaline; clear smooth boundary.

AC—4 to 11 inches; light brown (7.5YR 6/4) very channery loam, brown (7.5YR 4/4) moist; very weak fine granular structure; soft, very friable; about 75 percent brown (7.5YR 4/4) porcellanite fragments 0.5 inch to 2.0 inches in diameter; neutral; clear smooth boundary.

C—11 to 28 inches; dark yellowish brown (10YR 4/6) fragmented porcellanite grading to strong brown (7.5YR 5/6) in the lower part; single grain; yellowish brown (10YR 5/6) sandy loam occupies narrow voids between 1- to 3-inch fragments; neutral; gradual wavy boundary.

Ck—28 to 60 inches; red (2.5YR 5/6) porcellanite flagstones underlain by red (2.5YR 5/6) fractured porcellanite; traces of light reddish brown (2.5YR 6/3) sandy loam, mostly along vertical fractures, extend to a depth of about 45 inches; calcium carbonate coatings on underside of larger flagstones.

Depth to calcium carbonate and porcellanite ranges from 10 to 20 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. Reaction is neutral or mildly alkaline. Texture is commonly loam that has 20 to 60 percent porcellanite fragments.

The C horizon has hue of 10R to 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 to 6. Reaction is neutral to moderately alkaline. The horizon commonly is fractured porcellanite with loam or sandy loam in the voids in the upper part grading to largely in place fractured porcellanite with traces of soil in voids in the lower part.

Worf Series

The Worf series consists of shallow, well drained, moderately permeable soils on shoulder slopes, back slopes, and ridges and other summits of rolling uplands. These soils formed in residuum derived from interbedded shale and sandstone. Slope is 3 to 30 percent.

Typical pedon of a Worf fine sandy loam in an area of Worf-Shingle-Tassel complex, 3 to 30 percent slopes, in the NW1/4NW1/4NW1/4 of sec. 29, T. 35 N., R. 73 W.

A—0 to 2 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure parting to weak fine granular;

soft, loose, slightly sticky and slightly plastic; neutral; clear wavy boundary.
Bt1—2 to 8 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few thin clay films on ped faces; mildly alkaline; clear wavy boundary.
Bt2—8 to 14 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, sticky and plastic; common moderately thick clay films on ped faces; mildly alkaline; clear wavy boundary.
Bk—14 to 18 inches; light yellowish brown (2.5Y 5/3) sandy clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm, sticky and plastic; strongly effervescent; disseminated calcium carbonates and few fine calcium carbonate filaments; moderately alkaline; abrupt wavy boundary.
Cr—18 inches; soft calcareous shale.

Depth to calcium carbonate ranges from 7 to 18 inches, and depth to bedrock ranges from 14 to 19 inches. Rock fragment content is 0 to 18 percent but typically is less than 3 percent. In some areas gravel covers 15 percent of surface.

The A horizon has value 5 or 6 when dry and 3 to 5 when moist, and it has chroma of 2 or 3. It is fine sandy loam, sandy loam, or loam.

The Bt horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is sandy clay loam, clay loam, or loam and is 22 to 34 percent clay. Reaction is neutral to moderately alkaline.

The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4.

The Cr horizon is soft, interbedded shale and sandstone.

Worfka Series

The Worfka series consists of shallow, well drained, slowly permeable soils on summits and back slopes of undulating to rolling uplands. These soils formed in residuum derived from interbedded shale and sandstone. Slope is 0 to 15 percent.

Typical pedon of a Worfka fine sandy loam in an area of Renohill-Worfka-Shingle complex, 6 to 15 percent slopes, 2,640 feet south and 300 feet east of the northwest corner of sec. 21., T. 36 N., R. 70 W.

A—0 to 3 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to moderate very fine granular; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.
Bt—3 to 8 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; strong coarse subangular blocky structure parting to moderately fine subangular blocky; slightly hard, friable, sticky and plastic; many moderately thick clay films on faces of peds; mildly alkaline; gradual wavy boundary.
Btk—8 to 14 inches; light yellowish brown (10YR 6/4) clay loam, pale brown (10YR 6/3) moist; strong coarse subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, sticky and plastic; many moderately thick clay films on faces of peds; strongly effervescent; common fine irregularly shaped calcium carbonate in seams; moderately alkaline; gradual wavy boundary.
Cr—14 inches; soft calcareous shale.

Depth to bedrock ranges from 10 to 20 inches.

The A horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4. Texture is fine sandy loam, sandy loam, loam, or clay loam.

The Bt horizon has value 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4. It is clay or clay loam. Reaction is neutral to moderately alkaline.

The Btk horizon has hue of 2.5Y to 10YR, value of 5 to 7 when dry and 5 or 6 when moist, and chroma of 2 to 4. It is mildly alkaline to strongly alkaline.

The Cr horizon is soft interbedded shale and sandstone.

Zigweid Series

The Zigweid series consists of deep, well drained, moderately permeable soils on foot slopes, toe slopes, and alluvial flats. These soils formed in local alluvium derived dominantly from calcareous shale. Slope is 0 to 15 percent.

Typical pedon of a Zigweid clay loam in an area of Zigweid-Cambria-Theedle association, 6 to 15 percent slopes, 300 feet east and 1,800 feet north of the southwest corner of sec. 4, T. 38 N., R. 74 W.

A—0 to 3 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; weak medium platy structure parting to weak fine subangular blocky; hard, friable, sticky and plastic; neutral; abrupt smooth boundary.
Bw—3 to 9 inches; pale brown (10YR 6/3) clay loam, grayish brown (10YR 5/2) moist; moderate medium and fine subangular blocky structure; hard, friable, sticky and plastic; strongly effervescent; neutral; clear smooth boundary.
Bk1—9 to 28 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; violently effervescent; common fine soft masses and filaments of calcium carbonate; moderately alkaline; gradual smooth boundary.

Bk2—28 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and plastic; violently effervescent; few fine soft masses and filaments of calcium carbonate; moderately alkaline.

The A horizon has hue of 10YR or 2.5YR. Some pedons have weak platy structure in the surface layer. Texture is loam or clay loam. Reaction is neutral to moderately alkaline.

The Bw horizon has hue of 10YR or 2.5Y and chroma of 2 to 4. Reaction is neutral to moderately alkaline.

The Bk horizon has hue of 2.5YR or 10YR. Reaction centers on moderately alkaline. A Ck horizon is present in some pedons.

Formation of the Soils

The soils in the survey area are the product of complex interrelated processes. They are the result of living organisms and climate acting on parent material that has a particular relief over a period of time. The role of each of these factors in the formation of the soils is explained in the paragraphs that follow. This is followed by a discussion of the processes of soil horizon differentiation.

Parent Material

The soils of the survey area formed in sediment originally produced as a result of the uplift of the Rocky Mountains. During the period approximately 60 to 100 million years ago, this sediment was transported from the Laramie Range, and possibly from the Bighorn Range, and was deposited in the Powder River Basin as soft bedrock formations. These formations—the Lance, Fort Union, and Wasatch Formations—are thought to have been laid down as a result of receding water as opposed to earlier underlying formations that appear to have been deposited in a marine environment.

The Lance Formation, the oldest of the three formations, dates from the upper Cretaceous. It is in the western part of the survey area. The Fort Union Formation overlies the Lance Formation and dates from the lower Tertiary Period of the Paleocene Epoch. It is in the eastern and southern parts of the survey area and along the eastern side of Pine Ridge. The Fort Union Formation is overlain by the Wasatch Formation, in the central and northwestern parts of the survey area. It dates from the lower Tertiary Period of the Eocene Epoch. Subsequent overlying formations were thin and have eroded away.

The three formations are comprised of similar sediment, mostly interbedded sandstone and shale with discontinuous coal seams of variable thickness. The formations are weakly consolidated and thus susceptible to disintegration and erosion. Most soils in the survey area formed directly in residuum derived from bedrock of these formations or from sediment transported by gravity or by wind and water erosion.

The grain size of the parent material has a direct effect on the kind of soil that develops. For example, the Tullock soils formed in material derived from sandstone; therefore, they have much more sand, a lower available water capacity, more rapid permeability, and vegetation that is distinctly different from that on the Shingle soils, which formed in material derived from shale. Both soils formed on similar landscape positions, under the same climatic and biotic conditions, and over about the same length of time.

Local alluvium is material that had been transported downslope by moving water. Colluvium is material that has been transported downslope by the force of gravity. It is at the base of steeper slopes than is local alluvium. The characteristics of local alluvium and colluvium depend on the upslope source rather than the type of underlying rock. If the source is mixed kinds of rock, the soils that form will exhibit differing qualities. For example, the Forkwood soils formed in mixed local alluvium derived from interbedded sandstone and shale; therefore, they are more permeable and support different vegetation than Ulm soils that formed in local alluvium derived almost entirely from shale. The Ulm soils have more clay and are less permeable than the Forkwood soils.

Other less extensive sources of parent material in the survey area are stream alluvium and eolian sand of the Recent Epoch. Soils that formed in these materials show minimal development.

Recent alluvium is alluvial sediment that has been transported and deposited by streams. The source of this alluvium is impossible to locate because of the distances that it has been transported and the sorting of different-sized particles by water. Clarkelen and Haverdad are examples of soils that formed in Recent alluvium.

Stream terraces are older alluvial plains that have been isolated from the main stream by downcutting of the channel and formation of a new lower flood plain. The parent material is not subject to flooding, so additional sediment is not deposited on the terraces. Some of the Vonalee soils formed on stream terraces.

Eolian sand is derived from mixed sources, mainly sandstone and flood plains of larger streams Sand that is not protected by vegetation is moved by the wind and deposited as dunes on the downwind side of rock outcroppings and streams. Soils that formed in sand dunes include those of the Dwyer and Orpha series. Active dunes and sand blowouts are north of Glenrock.

Climate

Precipitation and temperature directly influence soil formation and development by their effect on the weathering of parent material, runoff and erosion, and the types of vegetation that can grow.

Rainfall, and snowfall to a lesser extent, provide the water necessary for soil formation. Water provides the energy to loosen and transport sediment. Given enough time, water will level the landscape which reduces slope gradients and leads to stabilization of the landscape.

Precipitation alters parent material in many ways. Water dissolves many minerals and contributes to chemical reactions. Some minerals are removed, and others are altered or moved into the soil profile. Water allows plant growth, and plants contribute organic material to the soil and help to stabilize the soil surface.

Temperature influences the rate of chemical reactions. Low temperatures allow frost action to disintegrate rock. Freezing and thawing influence soil structure. Temperature is also an important factor in plant growth.

The Shingle and Tassel soils that have a thin solum differ from other soils in the survey area primarily because of climatic influences. They differ from other Shingle and Tassel soils in that local precipitation and temperature are slightly higher. These differences are reflected by the presence of ponderosa pine and scattered juniper on the Shingle and Tassel soils that have a thin solum and grasses and shrubs on the other Shingle and Tassel soils.

Relief

Relief, the relative elevations of a land surface, affects soil formation by determining the stability of a given landscape position. Substantial erosion or accumulation of material removes or buries the developing soil. Generally, convex positions are more susceptible to erosion and concave positions are more susceptible to accumulation. Because soils on steeper slopes are less stable than those on gentler slopes, soils on ridge crests and steep back slopes generally exhibit less development than those on adjacent, less sloping foot slopes and toe slopes. At the other extreme, soils that formed in depressional areas and in the lower lying areas of alluvial flats accumulate sediment faster than horizons can mature.

Other soil properties that are related to relief are soil temperature and the amount of moisture and organic matter in the soil profile. North-facing side slopes receive less direct sunlight and as a result they are cooler and dry out more slowly than south-facing side slopes. Some slopes also tend to accumulate snow. Plant cover generally is denser, and more organic matter accumulates in the topsoil on the cooler slopes.

Plant and Animal Life

Plants and animals are significant in soil formation and development. Plants convert mineral nutrients, light energy, and water into organic compounds that eventually enrich the soil. Animals use plants, and animal wastes and remains are incorporated into the soil. Plant roots and burrowing animals tend to disturb soil layers while enhancing the movement of water and air in soil.

Darkening of the original parent material by addition of organic matter is the first observable step in the formation of many soils. Young soils are distinguishable from parent material solely by this addition. Grasses tend to encourage development of a darker-colored, thicker topsoil than do trees, which tie up organic compounds.

Both macro- and microfauna disturb the soil by burrowing. Badgers, prairie dogs, and smaller rodents move large quantities of subsoil and underlying material toward the soil surface. Abandoned burrows are eventually filled with topsoil. Worms and insects make many small burrows that promote soil aeration and water movement and that are less destructive of the soil horizons than the burrows of the larger animals. Forkwood soils are examples of soils that have high levels of activity from fungi, worms, and insects.

Time

Climate, relief, and plants and animals alter the parent material over a period of time. Time allows these factors to interact, and the relative influence of each varies considerably. Long periods of drought or excessive precipitation gradually alter the plant cover and the animal species that occupy the various habitats. Long periods of intense rainfall affect soil development by stripping away soil material, exposing parent material, or by burying soil material. High populations of grazing animals can deplete plant cover and expose soils to accelerated erosion.

The youngest soils in the survey area are those on flood plains, steep slopes, and dunes and those in depressional areas. These soils exhibit only a small amount of organic matter accumulation, are leached of salts, and are leached of some alkaline minerals. Draknab, Orpha, and Keeline soils are examples of young soils.

Soils of intermediate maturity have accumulated more organic matter, have a subsoil that is distinguishable by color or structure, and are leached of calcium carbonate or have accumulations of calcium carbonate. Zigweid soils are an example. These soils are thought to have formed under climatic conditions similar to those of the present time.

The next oldest soils have a distinct subsoil and accumulations of fine clay particles that generally overlie thick layers of calcium carbonate. Olney and Bidman soils are examples.

The oldest soils exhibit strong evidence of translocation and accumulation of fine clay within a 1-inch vertical distance at this upper boundary of the argillic horizon. The older the soil, the more likely it is that it was subject to higher precipitation during glacial periods. Bidman soils are an example.

Other factors being equal, the greater the length of time the parent material has been in place, the more development has taken place in the soil. For example, the Lohmiller, Silhouette, Ulm, and Bidman soils all formed in clayey sediment in nearly level to gently sloping areas. The minimal development of the Lohmiller soils, the intermediate development of the Silhouette soils, and the much stronger development of the Ulm and Bidman soils is directly proportional to the age of the positions they occupy.

Processes of Horizon Differentiation

Individual soil horizons form as a result of the four basic processes of addition, removal, transfer, and transformation of substances in the soil. These processes mainly act on organic matter, soluble salts, carbonates, or silicate clay minerals.

Addition of organic matter to the surface layer and transformation of organic matter into humus are the most common processes involved in horizon development. The profile of most of the soils in this survey area has also been leached of salt by the downward movement of water. This leaching has also transferred carbonates to varying depths in the soil. Accumulations of deeply leached carbonates are most prominent in the lower part of the subsoil. Unless sodium is present, carbonates must be leached in order for clay to be translocated from the surface layer to the subsoil. This is because sodium disperses clay particles and carbonates inhibit dispersion. Significant movement of fine clay by water into the subsoil creates an argillic horizon. Extensive removal of clay from the surface layer creates an eluvial horizon that is nearly devoid of clay and organic matter.

Some clayey soils in nearly level areas have accumulations of sodium and soluble salts because all the surface water cannot percolate through the profile; natric horizons result. In other soils that have a seasonal high water table, iron is transformed by oxidation and reduction. This results in mottling if the iron is segregated in the profile and in gleying if the iron is removed from the profile.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vol., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Culler, R.C. 1961. Hydrology of the Upper Cheyenne River Basin. U.S. Geol. Surv. Water Supply Pap. 1531, 198 pp.

(4) Portland Cement Association. 1962. PCA soil primer. 52 pp., illus.

(5) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(6) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(7) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(8) Wyoming Crop and Livestock Reporting Service. 1982. WY Agric. Stat., 89 pp., illus.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone. The material washed down the sides of mountains and hills by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvial flat. A nearly level, graded alluvial surface.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal-unit-month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep to very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4 1/2 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management. Use of mechanical, chemical, or biological methods to reduce or eliminate competition of woody vegetation to allow understory grasses and forbs to recover, or to make conditions favorable for reseeding. It increases production of

forage, which reduces erosion. Brush management may improve the habitat for some species of wildlife.

Butte. An isolated hill with steep or precipitous sides and a top variously flat, rounded, or pointed that is a residual mass isolated by erosion.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, calcium carbonatestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation by use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 milcalcium carbonateter, in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.

Coarse fragments. Mineral or rock particles larger than 2 milcalcium carbonateters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conglomerate. A coarse grained, clastic rock composed of rounded to subangular rock fragments more than 2 milcalcium carbonateters in diameter. It commonly has a matrix of sand and finer material. Conglomerate is the consolidated equivalent of gravel.

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.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cuesta. An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited for crop production unless irrigated.
Somewhat excessively drained.—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation only a narrow range of crops can be grown, and yields are low.
Well drained.—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.
Moderately well drained.—These soils are wet close enough to the surface for long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.
Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.
Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.
Very poorly drained.—These soils are wet to the surface most of the time. These soils are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

Duff. A term used to identify a generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. Synonym: scarp.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess calcium carbonate (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, and clay.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, calcium carbonatestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 milcalcium carbonateters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head.

High-residue crops. Crops such as small grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, carbonates, or a combination of these; (2) recognizable structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

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.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but

is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Local alluvium. Sediment that has been transported from hill slopes to adjacent foot slopes, toe slopes, and alluvial flats by runoff.

Low strength. The soil is not strong enough to support loads.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 milcalcium carbonateters (about 0.2 inch); *medium*, from 5 to 15 milcalcium carbonateters (about 0.2 to 0.6 inch); and *coarse*, more than 15 milcalcium carbonateters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma.

For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Observed rooting depth. Depth to which roots have been observed to penetrate.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting (in tables). Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Porcellanite. Baked clay or shale found in or adjacent to burned-out coal mines.

Potential native plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed. (See climax plant community.)

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. The application of fire to land under such conditions of weather, soil moisture, and time of day as presumably will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This increases the vigor and reproduction of the key plants and promotes the

accumulation of litter and mulch necessary to conserve soil and water.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 milcalcium carbonateters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 milcalcium carbonateter to 2.0 milcalcium carbonateters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and calcium carbonatestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 milcalcium carbonateter) to the lower limit of very fine sand (0.05 milcalcium carbonateter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site class. A grouping of site indexes into 5 to 7 production capability levels. Each level can be represented by a site curve.

Site curve (50-year). A set of related curves on a graph that shows the average height of dominant trees for the range of ages on soils that differ in productivity. each level is represented by a curve. The basis of the curves is the height of dominant trees that are 50 years old or are 50 years old at breast height.

Site curve (100-year). A set of related curves on a graph that show the average height of dominant and codominant trees for a range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant and codominant trees that are 100 years old or are 100 years old at breast height.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

	Percent
Nearly level	0 to 3
Gently sloping	3 to 6
Moderately sloping	6 to 10
Strongly sloping	10 to 15
Moderately steep	15 to 30
Steep	30 to 45
Very steep	45 and higher

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soft rock. Rock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 milcalcium carbonateters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Milcalcium carbonateters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Tail water. The water just downstream of a structure.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The action of uprooting and tipping over trees by the wind.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1952-70 at Dull Center, WY]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	Number of days: Maximum temperature higher than 90 °F	Number of days: Minimum temperature lower than 32 °F	Average number of growing degree days*	Record for month: High	Record for month: Low	Average	Average number of days with--: 0.10 inch or more	Average number of days with--: 0.5 inch or more
	°F	°F	°F	°F	°F	Units	°F	°F	In	In	In
January----	36.9	9.8	23.4	0	30	0	65	-31	0.29	1	---
February---	39.9	11.9	25.9	0	27	0	74	-49	0.27	1	---
March------	46.4	19.2	32.9	0	28	0	85	-28	0.56	2	---
April------	58.7	29.9	44.4	0	20	129	87	-21	1.49	4	---
May--------	68.8	40.0	54.2	---	4	446	94	12	2.31	5	1
June-------	79.2	48.8	64.0	6	---	720	104	28	2.25	5	1
July-------	90.1	56.3	73.3	18	0	1,029	111	38	1.48	3	1
August-----	88.4	53.1	70.7	18	0	953	104	32	1.29	2	---
September--	77.9	42.6	60.3	4	3	608	100	14	0.94	2	---
October----	65.9	32.5	49.0	0	15	279	89	0	0.80	1	0
November---	48.3	20.1	34.2	0	27	0	76	-24	0.39	1	---
December---	40.0	14.2	27.1	0	29	0	79	-33	0.27	1	0
Yearly:											
Average--	61.7	31.5	46.6	---	---	---	---	---	---	---	---
Total----	---	---	---	46	183	4,164	---	---	12.30	28	3

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for range vegetation in the area (40 °F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1952-70 at Dull Center, WY]

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 14	May 14	June 5
2 years in 10 later than--	May 8	May 17	May 30
5 years in 10 later than--	April 27	May 6	May 19
First freezing temperature in fall:			
1 year in 10 earlier than--	September 22	September 13	September 3
2 years in 10 earlier than--	September 29	September 19	September 9
5 years in 10 earlier than--	October 10	September 30	September 20

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map Symbol	Soil name	Acres	Percent
101	Absted-Arvada-Bone complex, 0 to 6 percent slopes	58,305	4.1
102	Aeric Haplaquepts, 0 to 3 percent slopes	4,525	0.3
103	Bahl-Savageton complex, 0 to 6 percent slopes	1,195	0.1
104	Cambria-Cushman complex, 0 to 6 percent slopes	7,665	0.5
105	Cambria-Cushman complex, 6 to 15 percent slopes	8,460	0.6
106	Cambria Variant-Forkwood Variant complex, 0 to 6 percent slopes	2,770	0.2
107	Clarkelen-Draknab complex, 0 to 3 percent slopes	13,960	1.0
108	Clarkelen-Dwyer-Orpha association, 0 to 10 percent slopes	12,080	0.8
109	Clarkelen-Haverdad-Bigwinder complex, 0 to 3 percent slopes	12,980	0.9
110	Cushman-Terro complex, 0 to 6 percent slopes	800	0.1
111	Cushman-Terro complex, 6 to 15 percent slopes	1,390	0.1
112	Cushman-Worf association, 6 to 15 percent slopes	14,925	1.0
113	Dwyer-Orpha loamy sands, 3 to 15 percent slopes	30,700	2.2
114	Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes	49,825	3.5
115	Forkwood-Cambria-Cushman complex, 6 to 15 percent slopes	29,355	2.1
116	Forkwood-Ulm complex, 0 to 6 percent slopes	30,975	2.2
117	Forkwood-Ulm-Renohill complex, 6 to 15 percent slopes	8,455	0.6
118	Gateson Variant-Tassel Variant association, 10 to 45 percent slopes	2,915	0.2
119	Gullied land	27,725	1.9
120	Haverdad-Lohmiller complex, 0 to 6 percent slopes	25,390	1.8
121	Hiland-Bowbac sandy loams, 0 to 6 percent slopes	89,970	6.3
122	Hiland-Bowback complex, 6 to 15 percent slopes	196,150	13.8
123	Keeline-Tassel-Turnback complex, 6 to 15 percent slopes	16,470	1.2
124	Kishona-Dwyer-Orpha association, 0 to 10 percent slopes	3,270	0.2
125	Orella-Rock outcrop-Samday complex, 3 to 30 percent slopes	17,580	1.2
126	Pits, mine	170	*
127	Renohill-Worfka-Shingle complex, 0 to 6 percent slopes	3,625	0.3
128	Renohill-Worfka-Shingle complex, 6 to 15 percent slopes	16,605	1.2
129	Samday-Shingle-Worf complex, 3 to 15 percent slopes	70,145	4.9
130	Sear-Wibaux complex, 0 to 15 percent slopes	2,875	0.2
131	Shingle-Rock outcrop-Samday complex, 10 to 30 percent slopes	173,505	12.2
132	Shingle, thin solum-Rock outcrop-Tassel, thin solum complex, cool, 6 to 45 percent slopes	4,890	0.3
133	Shingle-Theedle-Cambria association, 6 to 30 percent slopes	7,465	0.5
134	Silhouette-Heldt association, 0 to 6 percent slopes	8,655	0.6
135	Tassel-Shingle complex, 6 to 30 percent slopes	33,710	2.4
136	Tassel-Terro-Rock outcrop complex, 15 to 30 percent slopes	21,515	1.5
137	Tassel-Tullock-Vonalee association, 6 to 30 percent slopes	70,605	5.0
138	Terro-Tullock-Orpha complex, 0 to 6 percent slopes	1,540	0.1
139	Terro-Tullock-Orpha complex, 6 to 15 percent slopes	7,125	0.5
140	Theedle-Kishona association, 0 to 6 percent slopes	5,985	0.4
141	Theedle-Kishona association, 6 to 15 percent slopes	16,015	1.1
142	Ulm-Bidman complex, 0 to 6 percent slopes	25,920	1.8
143	Ulm-Renohill complex, 0 to 6 percent slopes	58,820	4.1
144	Ulm-Renohill clay loams, 6 to 15 percent slopes	28,205	2.0
145	Ustic Torriorthents, reclaimed, 3 to 30 percent slopes	3,145	0.2
146	Vonalee-Terro complex, 0 to 6 percent slopes	3,980	0.3
147	Vonalee-Terro complex, 6 to 15 percent slopes	8,710	0.6
148	Wibaux-Rock outcrop-Shingle complex, 6 to 45 percent slopes	21,675	1.5
149	Worf-Shingle-Tassel complex, 3 to 30 percent slopes	131,120	9.2
150	Zigweid-Bahl association, 0 to 6 percent slopes	7,215	0.5
151	Zigweid-Cambria association, 0 to 6 percent slopes	11,830	0.8
152	Zigweid-Cambria-Theedle association, 6 to 15 percent slopes	10,860	0.8
W	Water	1,813	0.1
	Total	1,425,558	100.0

* Less than 0.1 percent.

TABLE 4.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
	Acres	Acres	Acres	Acres
I (N)	---	---	---	---
(I)	---	---	---	---
II (N)	---	---	---	---
(I)	---	---	---	---
III (N)	---	---	---	---
(I)	---	---	---	---
IV (N)	363,910	338,520	25,390	---
(I)	---	---	---	---
V (N)	---	---	---	---
VI (N)	415,175	410,650	4,525	---
VII (N)	586,375	558,460	---	27,725
VIII (N)	---	---	---	---

TABLE 5.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
101*:				
Absted	Slight	Slight	Severe: excess sodium.	Slight.
Arvada	Moderate: percs slowly, dusty.	Moderate: percs slowly, dusty.	Moderate: percs slowly, slope.	Moderate: dusty.
Bone	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
102 Aeric Haplaquepts	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.
103*:				
Bahl	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Savageton	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight.
104*:				
Cambria	Slight	Slight	Moderate: slope.	Slight.
Cushman	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock.	Moderate: dusty.
105*:				
Cambria	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cushman	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
106*:				
Cambria Variant	Slight	Slight	Moderate: slope.	Slight.
Forkwood Variant	Slight	Slight	Moderate: slope.	Slight.
107*:				
Clarkelen	Severe: flooding.	Slight	Slight	Slight.
Draknab	Severe: flooding.	Slight	Slight	Slight.
108*:				
Clarkelen	Severe: flooding.	Slight	Slight	Slight.
Dwyer	Slight	Slight	Severe: slope.	Slight.
Orpha	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
109*:				
Clarkelen	Severe: flooding.	Slight	Slight	Slight.
Haverdad	Severe: flooding.	Slight	Slight	Slight.
Bigwinder	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.
110*:				
Cushman	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock.	Moderate: dusty.
Terro	Slight	Slight	Moderate: slope, depth to rock.	Slight.
111*:				
Cushman	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Terro	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
112*:				
Cushman	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Worf	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: dusty.
113*:				
Dwyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Orpha	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
114*:				
Forkwood	Slight	Slight	Moderate: slope, small stones.	Slight.
Cambria	Slight	Slight	Moderate: slope.	Slight.
115*:				
Forkwood	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cambria	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cushman	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
116*:				
Forkwood	Slight	Slight	Moderate: slope, small stones.	Slight.
Ulm	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
117*:				
Forkwood	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ulm	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Renohill	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
118*:				
Gateson Variant	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Tassel Variant	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
119*. Gullied land				
120*:				
Haverdad	Severe: flooding.	Moderate: excess salt.	Moderate: excess salt.	Slight.
Lohmiller	Severe: flooding.	Slight	Moderate: slope.	Slight.
121*:				
Hiland	Slight	Slight	Moderate: slope.	Slight.
Bowbac	Slight	Slight	Moderate: slope, depth to rock.	Slight.
122*:				
Hiland	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Bowbac	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
123*:				
Keeline	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Tassel	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Turnback	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
124*:				
Kishona	Moderate: excess salt.	Moderate: excess salt.	Moderate: slope, small stones, excess salt.	Slight.
Dwyer	Slight	Slight	Severe: slope.	Slight.
Orpha	Slight	Slight	Severe: slope.	Slight.
125*:				
Orella	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Rock outcrop.				
Samday	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
126*.				
Pits				
127*:				
Renohill	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Worfka	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight.
128*:				
Renohill	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Worfka	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
129*:				
Samday	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Worf	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: dusty.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
130*:				
Sear	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
Wibaux	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: slope, small stones.	Moderate: dusty.
131*:				
Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
Rock outcrop.				
Samday	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
132*:				
Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop.				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
133*:				
Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
Theedle	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cambria	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
134*:				
Silhouette	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
Heldt	Slight	Slight	Moderate: slope.	Slight.
135*:				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
136*:				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
136*:				
Terro	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Rock outcrop.				
137*:				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Tullock	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Vonalee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
138*:				
Terro	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Tullock	Slight	Slight	Moderate: slope.	Slight.
Orpha	Slight	Slight	Moderate: slope.	Slight.
139*:				
Terro	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Tullock	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Orpha	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
140*:				
Theedle	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Kishona	Moderate: excess salt.	Moderate: excess salt.	Moderate: slope, small stones, excess salt.	Slight.
141*:				
Theedle	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Kishona	Moderate: slope, excess salt.	Moderate: slope, excess salt.	Severe: slope.	Slight.
142*:				
Ulm	Slight	Slight	Moderate: slope.	Slight.
Bidman	Slight	Slight	Moderate: slope.	Slight.
143*:				
Ulm	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
143*: Renohill	Slight	Slight	Moderate: slope.	Slight.
144*: Ulm	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Renohill.				
145 Ustic Torriorthents	Variable	Variable	Variable	Variable.
146*: Vonalee	Slight	Slight	Moderate: slope.	Slight.
Terro	Slight	Slight	Moderate: slope, depth to rock.	Slight.
147*: Vonalee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Terro	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
148*: Wibaux	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
Rock outcrop.				
Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
149*: Worf	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
150*: Zigweid	Moderate: dusty.	Moderate: dusty.	Moderate: slope, small stones, dusty.	Moderate: dusty.
Bahl	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
151*: Zigweid	Slight	Slight	Moderate: slope, small stones.	Slight.

See footnote at end of table.

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
151*:				
Cambria	Slight	Slight	Moderate: slope.	Slight.
152*:				
Zigweid	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Cambria	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Theedle	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
101*:												
Absted	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Arvada	Very poor.	Very poor.	Poor	---	---	Very poor.	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.
Bone	Poor	Poor	Very poor.	---	---	Very poor.	---	---	Poor	---	---	Very poor.
102 Aeric haplaquepts	Poor	Poor	Fair	---	---	---	Good	Poor	Poor	---	Fair	Fair.
103*:												
Bahl	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Savageton	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
104*:												
Cambria	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Cushman	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
105*:												
Cambria	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Cushman	Poor	Poor	Fair	---	---	Fair	---	---	Poor	---	---	Fair.
106*:												
Cambria Variant	Fair	Good	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Forkwood Variant	Fair	Good	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
107*:												
Clarkelen	Fair	Fair	Fair	Fair	---	Fair	---	---	Fair	---	---	Fair.
Draknab	Fair	Fair	Fair	Fair	---	Fair	---	---	Fair	---	---	Fair.
108*:												
Clarkelen	Fair	Fair	Fair	Fair	---	Fair	---	---	Fair	---	---	Fair.
Dwyer	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Orpha	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
109*:												
Clarkelen	Fair	Fair	Fair	Fair	---	Fair	---	---	Fair	---	---	Fair.
Haverdad	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Bigwinder	Poor	Poor	Fair	Fair	---	Fair	---	---	Poor	---	---	Fair.
110*:												
Cushman	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Terro	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.

See footnote at end of table.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
111*:												
Cushman	Poor	Poor	Fair	---	---	Fair	---	---	Poor	---	---	Fair.
Terro	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
112*:												
Cushman	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Worf	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
113*:												
Dwyer	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Orpha	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
114*:												
Forkwood	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Cambria	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
115*:												
Forkwood	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Cambria	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Cushman	Poor	Poor	Fair	---	---	Fair	---	---	Poor	---	---	Fair.
116*:												
Forkwood	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Ulm	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
117*:												
Forkwood	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Ulm	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Renohill	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
118*:												
Gateson Variant.												
Tassel Variant	Very poor.	Very poor.	Poor	---	Very poor.	Poor	---	---	Very poor.	---	---	Poor.
119*.												
Gullied land												
120*:												
Haverdad	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Lohmiller	Good	Good	Good	Poor	Poor	Very poor.	Very poor.	Very poor.	Good	Poor	Very poor.	Good.

See footnote at end of table.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
121*:												
Hiland	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Bowbac	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
122*:												
Hiland	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Bowbac	Poor	Poor	Fair	---	---	Fair	---	---	Poor	---	---	Fair.
123*:												
Keeline	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Tassel	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Turnback	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
124*:												
Kishona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Dwyer	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Orpha	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
125*:												
Orella	Poor	Poor	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor.
Rock outcrop.												
Samday	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
126*. Pits												
127*:												
Renohill	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Worfka	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Shingle	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
128*:												
Renohill	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
Worfka	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
129*:												
Samday	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.

See footnote at end of table.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
129*:												
Shingle	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Worf	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
130*:												
Sear	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Wibaux	Very poor.	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
131*:												
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rock outcrop.												
Samday	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
132*:												
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rock outcrop	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
133*:												
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Theedle	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Cambria	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
134*:												
Silhouette	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Heldt	Fair	Fair	Poor	---	---	Poor	Poor	Very poor.	Fair	---	Very poor.	Poor.
135*:												
Tassel	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
136*:												
Tassel	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Terro	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rock outcrop.												

See footnote at end of table.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
137*:												
Tassel	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Tullock	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Vonalee	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
138*:												
Terro	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Tullock	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Orpha	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
139*:												
Terro	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Tullock	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Orpha	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
140*, 141*:												
Theedle	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Kishona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
142*:												
Ulm	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Bidman	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
143*:												
Ulm	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Renohill	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
144*:												
Ulm	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Renohill	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
145. Ustic Torriorthents												
146*:												
Vonalee	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Terro	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.

See footnote at end of table.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
147*:												
Vonalee	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Terro	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
148*:												
Wibaux	Very poor.	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
Rock outcrop.												
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
149*:												
Worf	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Shingle	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
150*:												
Zigweid	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Bahl	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
151*:												
Zigweid	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Cambria	Fair	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
152*:												
Zigweid	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Cambria	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.
Theedle	Poor	Fair	Fair	---	---	Fair	---	---	Fair	---	---	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
101*:						
Absted	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Arvada	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: droughty.
Bone	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: droughty.
102--- Aeric Haplaquepts	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
103*:						
Bahl	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
Savageton	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
104*:						
Cambria	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
Cushman	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
105*:						
Cambria	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope.
Cushman	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
106*:						
Cambria Variant	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
Forkwood Variant	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
107*:						
Clarkelen	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
107*:						
Draknab	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
108*:						
Clarkelen	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Dwyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Orpha	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
109*:						
Clarkelen	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Haverdad	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: excess salt.
Bigwinder	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.
110*:						
Cushman	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
Terro	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: large stones, thin layer.
111*:						
Cushman	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
Terro	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, slope, thin layer.
112*:						
Cushman	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
Worf	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
113*:						
Dwyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Orpha	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
114*:						
Forkwood	Slight	Slight	Slight	Slight	Slight	Slight.
Cambria	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
115*:						
Forkwood	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Cambria	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope.
Cushman	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
116*:						
Forkwood	Slight	Slight	Slight	Slight	Slight	Slight.
Ulm	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
117*:						
Forkwood	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Ulm	Moderate: too clayey, slope.	Severe: shrink-swell.	Moderate: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
Renohill	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: slope, depth to rock, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
118*:						
Gateson Variant	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, thin layer.
Tassel Variant	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
119*. Gullied land						
120*:						
Haverdad	Slight	Severe: flooding.	Severe: flooding.	Moderate: excess salt.	Moderate: flooding.	Moderate: excess salt.
Lohmiller	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Slight.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
121*:						
Hiland	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
Bowbac	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
122*:						
Hiland	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Bowbac	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: slope, thin layer.
123*:						
Keeline	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Tassel	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Turnback	Moderate: depth to rock.	Moderate: slope.	Moderate: slope, depth to rock.	Severe: slope.	Moderate: slope.	Moderate: slope.
124*:						
Kishona	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: excess salt.
Dwyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Orpha	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
125*:						
Orella	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, thin layer.
Rock outcrop.						
Samday	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, thin layer.
126*. Pits						
127*:						
Renohill	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: thin layer.
Worfka	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
127*:						
Shingle	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: depth to rock, low strength.	Severe: thin layer.
128*:						
Renohill	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, depth to rock, slope.	Severe: slope.	Severe: low strength.	Moderate: thin layer.
Worfka	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock.	Severe: slope.	Severe: low strength.	Severe: thin layer.
Shingle	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.	Severe: thin layer.
129*:						
Samday	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Severe: thin layer.
Shingle	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.	Severe: thin layer.
Worf	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
130*:						
Sear	Slight	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Wibaux	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: droughty.
131*:						
Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.						
Samday	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, thin layer.
132*:						
Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
133*:						
Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Theedle	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope, thin layer.
Cambria	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope.
134*:						
Silhouette	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Heldt	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
135*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
136*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Terro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.						
137*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Tullock	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, thin layer.
Vonalee	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
138*:						
Terro	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: large stones, thin layer.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
138*:						
Tullock	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty, thin layer.
Orpha	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
139*:						
Terro	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, slope, thin layer.
Tullock	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, thin layer.
Orpha	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
140*:						
Theedle	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: thin layer.
Kishona	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: excess salt.
141*:						
Theedle	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope, thin layer.
Kishona	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, shrink-swell.	Moderate: excess salt, slope.
142*:						
Ulm	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Bidman	Slight	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
143*:						
Ulm	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Renohill	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell. slope.	Severe: low strength,	Moderate: thin layer.
144*:						
Ulm	Moderate: too clayey, slope.	Severe: shrink-swell.	Moderate: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
144*:						
Renohill	Moderate: depth to rock, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope, thin layer.
145	Variable	Variable	Variable	Variable	Variable	Variable.
Ustic Torriorthents						
146*:						
Vonalee	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Terro	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: large stones, thin layer.
147*:						
Vonalee	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Terro	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, slope, thin layer.
148*:						
Wibaux	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: droughty, slope.
Rock outcrop.						
Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
149*:						
Worf	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
150*:						
Zigweid	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Bahl	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
151*:						
Zigweid	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
151*: Cambria	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
152*: Zigweid	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Cambria	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope.
Theedle	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
101*:			
Absted	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.
Arvada	Severe: percs slowly.	Moderate: slope.	Slight.
Bone	Severe: percs slowly.	Moderate: slope.	Slight.
102 Aeric Haplaquepts	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.
103*:			
Bahl	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.
Savageton	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.
104*:			
Cambria	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
Cushman	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
105*:			
Cambria	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
Cushman	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
106*:			
Cambria Variant	Moderate: percs slowly.	Moderate: seepage, slope.	Slight.
Forkwood Variant	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
107*:			
Clarkelen	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage.
Draknab	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy.
108*:			
Clarkelen	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
108*:			
Dwyer	Severe: poor filter.	Severe: seepage.	Severe: too sandy.
Orpha	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.
109*:			
Clarkelen	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage.
Haverdad.			
Bigwinder	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.
110*:			
Cushman	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Terro	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.
111*:			
Cushman	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Terro	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.
112*:			
Cushman	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Worf	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
113*:			
Dwyer	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.
Orpha	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.
114*:			
Forkwood	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
Cambria	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
115*:			
Forkwood	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
Cambria	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
Cushman	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
116*:			
Forkwood	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
Ulm	Severe: percs slowly.	Moderate: seepage, slope.	Slight.
117*:			
Forkwood	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
Ulm	Severe: percs slowly.	Severe: slope.	Moderate: slope.
Renohill	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.
118*:			
Gateson Variant	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.
Tassel Variant	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
119*. Gullied land			
120*:			
Haverdad	Moderate: flooding, percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.
Lohmiller	Severe: percs slowly.	Severe: flooding.	Moderate: flooding.
121*:			
Hiland	Severe: poor filter.	Severe: seepage.	Severe: seepage.
Bowbac	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
122*:			
Hiland	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.
Bowbac	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
123*:			
Keeline	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.
Tassel	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.
Turnback	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
124*:			
Kishona	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
Dwyer	Severe: poor filter.	Severe: seepage.	Severe: too sandy.
Orpha	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.
125*:			
Orella	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock outcrop.			
Samday	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.
126*. Pits			
127*:			
Renohill	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.
Worfka	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
128*: Renohill.			

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
128*:			
Worfka	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Shingle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
129*:			
Samday	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.
Shingle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Worf	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
130*:			
Sear	Severe: poor filter.	Severe: seepage, slope.	Moderate: large stones.
Wibaux	Severe: poor filter, large stones.	Severe: seepage, slope, large stones.	Severe: large stones.
131*:			
Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock outcrop.			
Samday	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.
132*:			
Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock outcrop.			
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.
133*:			
Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Theedle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
133*:			
Cambria	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
134*:			
Silhouette	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.
Heldt	Severe: percs slowly.	Moderate: slope.	Slight.
135*:			
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.
Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
136*:			
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.
Terro	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.
Rock outcrop.			
137*:			
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.
Tullock	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope.
Vonalee	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope, too sandy.
138*:			
Terro	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.
Tullock	Severe: poor filter.	Severe: seepage.	Slight.
Orpha	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
139*:			
Terro	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.
Tullock	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope.
Orpha	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.
140*:			
Theedle	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Kishona	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
141*:			
Theedle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Kishona	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
142*:			
Ulm	Severe: percs slowly.	Moderate: seepage, slope.	Slight.
Bidman	Severe: percs slowly.	Moderate: slope.	Slight.
143*:			
Ulm	Severe: percs slowly.	Moderate: seepage, slope.	Slight.
Renohill	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.
144*:			
Ulm	Severe: percs slowly.	Severe: slope.	Moderate: slope.
Renohill	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.
145 Ustic Torriorthents	Variable	Variable	Variable.
146*:			
Vonalee	Severe: poor filter.	Severe: seepage.	Moderate: too sandy.
Terro	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill
147*:			
Vonalee	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope, too sandy.
Terro	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.
148*:			
Wibaux	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: slope, large stones.
Rock outcrop.			
Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
149*:			
Worf	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.
150*:			
Zigweid	Moderate: percs slowly.	Moderate: seepage, slope.	Slight.
Bahl	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.
151*:			
Zigweid	Moderate: percs slowly.	Moderate: seepage, slope.	Slight.
Cambria	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.
152*:			
Zigweid	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.
Cambria	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.
Theedle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
101*:				
Absted	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Arvada.				
Bone	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
102	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Aeric Haplaquepts				
103*:				
Dahl	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Savageton	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
104*:				
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cushman	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
105*:				
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Cushman	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
106*:				
Cambria Variant	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Forkwood Variant	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
107*:				
Clarkelen	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
Draknab	Good	Probable	Improbable: too sandy.	Poor: thin layer.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
108*:				
Clarkelen	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
Dwyer	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Orpha	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
109*:				
Clarkelen	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
Haverdad	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, excess salt.
Bigwinder	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
110*:				
Cushman	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
111*:				
Cushman	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
112*:				
Cushman	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Worf	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
113*:				
Dwyer	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Orpha	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
114*:				
Forkwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
114*:				
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
115*:				
Forkwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Cushman	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
116*:				
Forkwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Ulm	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
117*:				
Forkwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Ulm	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Renohill	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
118*:				
Gateridge	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Tassel Variant	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
119*. Gullied land				
120*:				
Haverdad	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Lohmiller	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
121*:				
Hiland	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Bowbac	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
122*:				
Hiland	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Bowbac	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
123*:				
Keeline	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Tassel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Turnback	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Moderate: area reclaim, slope.
124*:				
Kishona	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Dwyer	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Orpha	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
125*:				
Orella	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Rock outcrop.				
Samday	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
126*. Pits				
127*:				
Renohill	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Worfka	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
128*:				
Renohill	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Worfka	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
128*:				
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
129*:				
Samday	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Worf	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
130*:				
Sear	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
Wibaux	Poor: large stones.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim.
131*:				
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
Samday	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
132*:				
Shingle	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
Tassel	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
133*:				
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Theedle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
134*:				
Silhouette	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Heldt	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
135*:				
Tassel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
136*:				
Tassel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock outcrop.				
137*:				
Tassel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Tullock	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too sandy, slope.
Vonalee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones, slope.
138*:				
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Tullock	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too sandy.
Orpha	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
139*:				
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
Tullock	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too sandy, slope.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
139*: Orpha	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
140*: Theedle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Kishona	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
141*: Theedle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
Kishona	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
142*: Ulm	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Bidman	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
143*, 144*: Ulm	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Renohill	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
145 Ustic Torriorthents	Variable	Variable	Variable	Variable.
146*: Vonalee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
147*: Vonalee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones, slope.
Terro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
148*: Wibaux	Poor: large stones, slope.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim, slope.
Rock outcrop.				

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
148*:				
Shingle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
149*:				
Worf	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Shingle	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Tassel	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
150*:				
Zigweid	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Bahl	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
151*:				
Zigweid	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
152*:				
Zigweid	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Cambria	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Theedle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
101*:					
Absted	Moderate: slope.	Severe: excess salt.	Deep to water	Soil blowing, percs slowly, slope.	Erodes easily, excess sodium.
Arvada.					
Bone	Moderate: slope.	Moderate: hard to pack, excess salt.	Deep to water	Droughty, percs slowly.	Erodes easily, droughty.
102 Aeric Haplaquepts	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly.	Wetness, percs slowly.
103*:					
Bahl	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Erodes easily, percs slowly.
Savageton	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Erodes easily, depth to rock.
104*:					
Cambria	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily.
Cushman	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Erodes easily, depth to rock.
105*:					
Cambria	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily.
Cushman	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
106*:					
Cambria Variant	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Soil blowing, slope.	Erodes easily.
Forkwood Variant	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily.
107*:					
Clarkelen	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable.
Draknab	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
108*:					
Clarkelen	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable.
Dwyer	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Orpha	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
109*:					
Clarkelen	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable.
Haverdad	Moderate: seepage.	Severe: piping.	Deep to water	Excess salt.	Favorable.
Bigwinder	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, soil blowing, flooding.	Wetness.
110*:					
Cushman	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Erodes easily, depth to rock.
Terro	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Depth to rock.
111*:					
Cushman	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Terro	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Slope, depth to rock.
112*:					
Cushman	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Worf	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
113*:					
Dwyer	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
Orpha	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
114*:					
Forkwood	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Soil blowing, slope.	Favorable.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
114*: Cambria	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily.
115*: Forkwood	Severe: slope.	Moderate: piping.	Deep to water	Soil blowing, slope.	Slope.
Cambria	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily.
Cushman	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
116*: Forkwood	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Soil blowing, slope.	Favorable.
Ulm	Moderate: seepage, slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.
117*: Forkwood	Severe: slope.	Moderate: piping.	Deep to water	Soil blowing, slope.	Slope.
Ulm	Severe: slope.	Slight	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.
Renohill	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.
118*: Gateridge	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Fast intake, soil blowing, percs slowly.	Slope, depth to rock, percs slowly.
Tassel Variant	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock, slope.	Slope, erodes easily, depth to rock.
119*. Gullied land					
120*: Haverdad	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope, excess salt.	Excess salt, erodes easily.
Lohmiller	Moderate: slope.	Moderate: hard to pack, piping.	Deep to water	Percs slowly, slope.	Percs slowly.
121*: Hiland	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope	Favorable.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
121*:					
Bowbac	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Erodes easily, depth to rock.
122*:					
Hiland	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope	Slope.
Bowbac	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, erodes easily, depth to rock.
123*:					
Keeline	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, soil blowing.	Slope, droughty.
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Slope, depth to rock.
Turnback	Severe: seepage, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing, depth to rock.	Slope, depth to rock, too sandy.
124*:					
Kishona	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, excess salt.	Excess salt.
Dwyer	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Orpha	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
125*:					
Orella	Severe: depth to rock, slope.	Severe: hard to pack.	Deep to water	Droughty, percs slowly.	Slope, droughty, depth to rock.
Rock outcrop.					
Samday	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Slope, erodes easily, depth to rock.
126*. Pits					
127*:					
Renohill	Moderate: depth to rock, slope.	Moderate: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock.
Worfka	Severe: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
127*:					
Shingle	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Erodes easily, depth to rock.
128*:					
Renohill	Severe: slope.	Moderate: thin layer.	Deep to water	Percs slowly, depth to rock. slope.	Slope, depth to rock.
Worfka	Severe:	Severe:	Deep to water	Depth to rock,	Slope,
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
129*:					
Samday	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Slope, erodes easily, depth to rock.
129*:					
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Worf	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
130*:					
Sear	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Large stones, droughty.
Wibaux	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Large stones, droughty.
131*:					
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Rock outcrop.					
Samday	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Slope, erodes easily, depth to rock.
132*:					
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Rock outcrop.					
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Slope, depth to rock.
133*:					
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
133*:					
Theedle	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Cambria	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily.
134*:					
Silhouette	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.
Heldt	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope.	Excess salt, percs slowly.
135*:					
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock.
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
136*:					
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Slope, depth to rock.
Terro	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Slope, depth to rock.
Rock outcrop.					
137*:					
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Slope, depth to rock.
Tullock	Severe: seepage, slope.	Severe: thin layer, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty, depth to rock.
Vonalee	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
138*:					
Terro	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Depth to rock.
Tullock	Severe: seepage.	Severe: thin layer, piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty, depth to rock.
Orpha	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing	Droughty.
139*:					
Terro	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Slope, depth to rock.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
139*:					
Tullock	Severe: seepage, slope.	Severe: thin layer, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty, depth to rock.
Orpha	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
140*:					
Theedle	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Erodes easily, depth to rock.
Kishona	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, excess salt.	Excess salt.
141*:					
Theedle	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Kishona	Severe: slope.	Severe: piping.	Deep to water	Slope, excess salt.	Slope, excess salt.
142*:					
Ulm	Moderate: seepage, slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.
Bidman	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.
143*:					
Ulm	Moderate: seepage, slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.
Renohill	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.
144*:					
Ulm	Severe: slope.	Slight	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.
Renohill	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.
145 Ustic Torriorthents	Variable	Variable	Variable	Variable	Variable.
146*:					
Vonalee	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Terro	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Depth to rock.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
147*:					
Vonalee	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
Terro	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Slope, depth to rock.
148*:					
Wibaux	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Large stones, slope, droughty.
Rock outcrop.					
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
149*:					
Worf	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock.
150*:					
Zigweid	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily.
Bahl	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Erodes easily, percs slowly.
151*:					
Zigweid	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily.
Cambria	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily.
152*:					
Zigweid	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.
Cambria	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily.
Theedle	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, erodes easily, depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
101*:											
Absted----------	0-3	Fine sandy loam	SM	A-4	0-5	85-100	85-100	65-80	35-50	15-20	NP-5
	30-60	Clay, clay loam	CH, CL	A-7	0	85-100	85-100	80-100	70-95	40-60	20-30
Arvada----------	0-3	Loam----------	CL-ML	A-4	0	90-100	95-100	85-95	70-80	15-25	5-10
	3-22	Clay	CL, CH	A-7	0	80-100	75-100	70-100	65-95	40-65	20-35
	22-60	Clay	CL	A-7	0	80-100	75-100	70-100	55-90	40-45	20-25
Bone----------	0-2	Clay loam--------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-15
	2-5	Clay loam--------	CL, CH	A-7	0	90-100	90-100	80-90	70-80	40-55	20-35
	5-60	Clay loam, clay	CL, CH	A-7	0	90-100	90-100	80-90	70-80	40-55	20-35
102----------	0-8	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	75-90	35-50	15-25
Aeric Haplaquepts	8-60	Clay----------	CL, CH	A-7	0	100	100	90-100	80-95	45-65	25-40
103*:											
Bahl----------	0-4	Clay----------	CL	A-6, A-7	0	100	95-100	85-100	60-80	35-45	15-25
	4-60	Clay----------	CL, CH	A-7	0	100	100	90-100	85-95	40-60	20-35
Savageton-------	0-2	Clay loam--------	CL, CH	A-7	0	100	100	90-100	85-95	40-55	20-35
	2-32	Clay----------	CL, CH	A-7	0	100	100	90-100	85-95	40-55	20-35
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
104*:											
Cambria---------	0-2	Fine sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	2-10	Sandy clay loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	75-85	55-75	25-40	5-15
	10-60	Loam----------	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	25-40	5-15
Cushman---------	0-4	Loam----------	CL-ML, ML	A-4	0	90-100	90-100	70-85	60-70	20-30	NP-10
	4-15	Clay loam--------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	15-33	Sandy clay loam, clay loam	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	33	Weathered bedrock	---	---	---	---	---	---	---	---	---
105*:											
Cambria---------	0-4	Sandy loam--------	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	4-8	Loam----------	CL-ML, ML	A-4	0	95-100	95-100	75-85	60-70	20-30	NP-10
	8-60	Loam----------	CL-ML, CL	A-4, A-6	0	95-100	95-100	75-85	55-75	25-40	5-15
Cushman---------	0-3	Loam----------	CL-ML, ML	A-4	0	90-100	90-100	70-85	60-70	20-30	NP-10
	3-17	Clay loam--------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	17-25	Loam----------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	25	Weathered bedrock	---	---	---	---	---	---	---	---	---
106*:											
Cambria Variant-	0-2	Fine sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	---	NP
	2-16	Clay loam, loam	CL	A-6	0	95-100	95-100	75-85	60-70	30-40	10-15
	16-60	Stratified clay loam to sandy loam.	CL	A-6	0	95-100	95-100	75-85	55-65	25-35	10-15

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
106*:											
Forkwood Variant	0-3	Clay loam--------	CL	A-6	0	95-100	95-100	75-90	55-70	25-40	10-15
	3-16	Clay loam--------	CL	A-6	0	95-100	95-100	80-95	65-80	30-40	10-15
	16-60	Stratified fine sandy loam to clay loam.	CL-ML, CL	A-4, A-6	0	95-100	95-100	60-80	50-65	20-35	5-15
107*:											
Clarkelen-------	0-3	Sandy loam-------	SM	A-2, A-4	0	100	95-100	55-75	25-40	20-25	NP-5
	3-60	Stratified sand to silt loam	SM	A-2	0-5	95-100	90-100	55-70	25-35	---	NP
Draknab---------	0-2	Loamy sand-------	SM	A-2	0	100	95-100	50-70	20-35	---	NP
	2-60	Stratified sandy loam to sand.	SM, SP-SM	A-1, A-2, A-3	0-5	95-100	85-100	45-60	5-25	---	NP
108*:											
Clarkelen-------	0-3	Sandy loam-------	SM	A-2, A-4	0	100	95-100	55-75	25-40	20-25	NP-5
	3-60	Stratified sand to silt loam.	SM	A-2	0-5	95-100	90-100	55-70	25-35	---	NP
Dwyer-----------	0-5	Loamy sand-------	SM	A-2	0	100	100	65-80	20-35	---	NP
	5-60	Loamy sand-------	SP-SM, SM	A-3, A-2	0	85-100	75-100	50-80	5-35	---	NP
Orpha-----------	0-5	Loamy sand-------	SM	A-2	0	100	95-100	50-60	20-30	---	NP
	5-60	Sand-------------	SM	A-2	0	100	95-100	60-80	15-35	---	NP
109*:											
Clarkelen-------	0-3	Sandy loam-------	SM	A-2, A-4	0	100	95-100	55-75	25-40	20-25	NP-5
	3-60	Stratified sand to silt loam.	SM	A-2	0-5	95-100	90-100	55-70	25-35	---	NP
Haverdad--------	0-6	Fine sandy loam	SM, ML	A-4	0	75-100	75-100	60-90	35-65	15-20	NP-5
	6-60	Stratified fine sandy loam to clay loam.	CL-ML, CL	A-4, A-6	0	75-100	75-100	70-90	50-60	25-35	5-15
Bigwinder-------	0-3	Fine sandy loam	SM	A-2	0	100	95-100	65-80	25-35	---	NP
	3-24	Stratified sand to loam.	SM, SM-SC	A-4	0	100	95-100	50-70	35-45	15-30	NP-10
110*:											
Cushman---------	0-4	Loam-------------	CL-ML, ML	A-4	0	90-100	90-100	70-85	60-70	20-30	NP-10
	4-15	Clay loam--------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	15-33	Loam, clay loam	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	33	Weathered bedrock	---	---	---	---	---	---	---	---	---
Terro-----------	0-4	Sandy loam-------	SM	A-2, A-4	0-15	100	100	60-90	30-45	---	NP
	4-23	Sandy loam-------	SM	A-2, A-4	0-15	100	100	60-90	30-45	20-25	NP-5
	23-34	Sandy loam-------	SM	A-2, A-4	0-15	100	100	60-90	30-40	20-25	NP-5
	34	Weathered bedrock	---	---	---	---	---	---	---	---	---
111*:											
Cushman---------	0-3	Loam-------------	CL-ML, ML	A-4	0	90-100	90-100	70-85	60-70	20-30	NP-10
	3-17	Clay loam--------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	17-25	Loam-------------	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	25	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111*:											
Terro	0-4	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	---	NP
	4-23	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	20-25	NP-5
	23-34	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-40	20-25	NP-5
	34	Weathered bedrock	---	---	---	---	---	---	---	---	---
112*:											
Cushman	0-3	Loam	CL-ML, ML	A-4	0	90-100	90-100	70-85	60-70	20-30	NP-10
	3-17	Clay loam	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	17-25	Loam	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	25	Weathered bedrock	---	---	---	---	---	---	---	---	---
Worf	0-2	Fine sandy loam	SM	A-4	0	100	95-100	70-95	35-45	---	NP
	2-18	Sandy clay loam	CL	A-6	0	100	95-100	65-85	60-75	25-40	10-20
	18	Weathered bedrock	---	---	---	---	---	---	---	---	---
113*:											
Dwyer	0-5	Loamy sand	SM	A-2	0	100	100	65-80	20-35	---	NP
	5-60	Loamy sand	SP-SM, SM	A-3, A-2	0	85-100	75-100	50-80	5-35	---	NP
Orpha	0-6	Loamy sand	SM	A-2	0	100	95-100	50-60	20-30	---	NP
	6-60	Sand	SM	A-2	0	100	95-100	60-80	15-35	---	NP
114*:											
Forkwood	0-7	Fine sandy loam	SM	A-2	0	75-100	75-100	50-85	20-35	20-25	NP-5
	7-60	Clay loam	CL	A-6	0	75-100	75-100	70-90	55-75	25-35	10-20
Cambria	0-2	Fine sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	2-10	Sandy clay loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	75-85	55-75	25-40	5-15
	10-60	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	25-40	5-15
115*:											
Forkwood	0-5	Fine sandy loam	SM	A-2	0	75-100	75-100	50-85	20-35	20-25	NP-5
	5-18	Clay loam	CL	A-6	0	75-100	75-100	70-90	55-75	25-35	10-20
	18-60	Loam	CL	A-6	0	75-100	75-100	70-90	55-75	25-40	10-25
Cambria	0-4	Sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	4-8	Loam	CL-ML, ML	A-4	0	95-100	95-100	75-85	60-70	20-30	NP-10
	8-60	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	25-40	5-15
Cushman	0-3	Loam	CL-ML, ML	A-4	0	90-100	90-100	70-85	60-70	20-30	NP-10
	3-17	Clay loam	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	17-25	Loam	CL	A-6	0	90-100	90-100	80-90	70-80	30-40	10-20
	25	Weathered bedrock	---	---	---	---	---	---	---	---	---
116*:											
Forkwood	0-7	Fine sandy loam	SM	A-2	0	75-100	75-100	50-85	20-35	20-25	NP-5
	7-60	Clay loam	CL	A-6	0	75-100	75-100	70-90	55-75	25-35	10-20
Ulm	0-5	Loam	CL-ML	A-4	0-5	95-100	95-100	80-100	70-80	20-30	5-10
	5-21	Clay loam, clay	CL	A-6, A-7	0-5	75-100	75-100	75-100	60-80	35-45	20-30
	21-36	Clay loam	CL	A-6	0-5	75-100	75-100	75-100	60-80	30-40	15-20
	36-60	Sandy clay loam	CL, SC	A-6	0-5	75-100	75-100	70-90	40-55	30-40	10-20
117*:											
Forkwood	0-7	Fine sandy loam	SM	A-2	0	75-100	75-100	50-85	20-35	20-25	NP-5
	7-60	Clay loam	CL	A-6	0	75-100	75-100	70-90	55-75	25-35	10-20
Ulm	0-4	Clay loam	CL	A-6	0-5	95-100	95-100	80-100	70-80	30-40	10-20
	4-16	Clay loam	CL	A-6, A-7	0-5	75-100	75-100	75-100	60-80	35-45	20-30
	16-60	Clay loam	CL	A-6	0-5	75-100	75-100	75-100	60-80	30-40	15-20

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
117*:											
Renohill--------	0-5	Clay loam--------	CL	A-6	0	85-100	80-100	80-95	70-90	30-40	10-20
	5-25	Clay loam--------	CL	A-6	0	85-100	80-100	80-95	70-80	30-40	15-25
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
118*:											
Gateridge-------	0-4	Loamy sand-------	SM	A-2	0	100	85-100	75-90	15-30	---	NP
	4-11	Sandy clay loam	SC, CL	A-6	0	100	85-100	80-100	35-55	25-35	10-20
	11-16	Clay-------------	CL, CH	A-7, A-6	0	100	80-100	80-100	60-90	30-60	15-35
	16	Weathered bedrock	---	---	---	---	---	---	---	---	---
Tassel Variant--	0-4	Very fine sandy loam.	SM	A-4	0-5	100	95-100	80-95	35-45	15-25	NP-5
	4-9	Loam-------------	CL-ML, SM-SC	A-4	0	100	95-100	70-85	45-55	20-30	5-10
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
119*. Gullied land											
120*:											
Haverdad--------	0-6	Fine sandy loam	SM, ML	A-4	0	75-100	75-100	60-90	35-65	15-20	NP-5
	6-60	Stratified fine sandy loam to clay loam.	CL-ML, CL	A-4, A-6	0	75-100	75-100	70-90	50-60	25-35	5-15
Lohmiller-------	0-3	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	70-85	35-50	12-25
	3-60	Stratified sandy loam to clay.	CL, CH	A-6, A-7	0	95-100	95-100	90-100	65-95	35-60	12-30
121*:											
Hiland----------	0-5	Sandy loam-------	SM	A-2, A-4	0	95-100	90-100	65-75	30-40	20-25	NP-5
	5-30	Sandy clay loam	SC,CL	A-6	0	95-100	90-100	60-80	40-60	30-40	10-20
	30-60	Sandy Loam	SM	A-2	0	85-100	75-100	45-75	15-30	20-25	NP-5
Bowbac----------	0-3	Sandy loam-------	SM	A-2	0	90-100	90-100	65-80	35-50	15-25	NP-5
	3-18	Sandy clay loam	CL	A-6	0	90-100	90-100	70-85	50-60	25-40	10-20
	18-36	Sandy loam-------	SM-ML, SM-SC, CL-ML	A-4, A-6	0	90-100	90-100	60-80	45-55	25-35	5-15
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
122*:											
Hiland----------	0-3	Sandy clay loam	SC	A-2, A-6	0	95-100	90-100	65-85	30-45	30-35	10-15
	3-60	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	60-80	40-60	30-40	10-20
Bowbac----------	0-3	Sandy loam-------	SM	A-2	0	90-100	90-100	65-80	35-50	15-25	NP-5
	3-18	Sandy clay loam	CL	A-6	0	90-100	90-100	70-85	50-60	25-40	10-20
	18-36	Sandy loam-------	SM, ML, SM-SC, CL-ML	A-4, A-6	0	90-100	90-100	60-80	45-55	25-35	5-15
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
123*:											
Keeline---------	0-8	Sandy loam-------	SM	A-2, A-4	0	100	95-100	55-75	25-40	20-25	NP-5
	8-60	Sandy loam-------	SM, SM-SC	A-2, A-4	0	100	95-100	60-85	25-50	20-30	NP-10

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
123*:											
Tassel	0-2	Loamy fine sand	SM	A-2	0	95-100	90-100	65-95	15-30	---	NP
	2-16	Fine sandy loam,	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Turnback	0-4	Loamy fine sand	SM	A-2	0	100	95-100	75-90	20-35	---	NP
	4-30	Sandy loam	SM	A-2, A-4	0	100	95-100	60-80	30-40	15-25	NP-5
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
124*:											
Kishona	0-3	Loam	ML	A-4	0	85-100	75-100	65-85	55-75	25-30	NP-5
	3-60	Clay loam	CL-ML, CL	A-4, A-6	0	85-100	75-100	70-90	65-85	20-30	5-15
Dwyer	0-5	Loamy sand	SM	A-2	0	100	100	65-80	20-35	---	NP
	5-60	Loamy sand	SP-SM, SM	A-3, A-2	0	85-100	75-100	50-80	5-35	---	NP
Orpha	0-5	Loamy sand	SM	A-2	0	100	95-100	50-60	20-30	---	NP
	5-60	Loamy sand	SM	A-2	0	100	95-100	60-80	15-35	---	NP
125*:											
Orella	0-4	Clay loam	CH, CL	A-6, A-7	0	100	100	95-100	70-95	38-65	20-40
	4-20	Clay	CH	A-7	0	100	100	90-100	75-95	50-70	30-50
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
Samday	0-2	Clay loam	CL	A-6, A-7	0	100	90-100	85-95	75-90	35-50	15-30
	2-18	Clay	CL, CH	A-6	0	100	95-100	85-100	75-95	40-55	20-30
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
126*. Pits											
127*:											
Renohill	0-5	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-80	35-55	20-25	NP-5
	5-20	Clay	CL, CH	A-7, A-6	0	95-100	90-100	90-100	75-95	35-65	20-35
	20-36	Clay loam	CL	A-6	0	85-100	80-100	80-95	70-80	30-40	15-25
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Worfka	0-6	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-80	35-55	20-25	NP-5
	6-18	Clay loam, clay	CL	A-6, A-7	0	95-100	90-100	85-95	75-90	35-45	NP
	18	Weathered bedrock	---	---	---	---	---	---	---	---	---
Shingle	0-4	Clay loam	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-18	Clay loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
128*:											
Renohill	0-5	Clay loam	CL	A-6	0	85-100	80-100	80-95	70-90	30-40	10-20
	5-25	Clay loam	CL	A-6	0	85-100	80-100	80-95	70-80	30-40	15-25
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Worfka	0-3	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-80	35-55	20-25	NP-5
	3-14	Clay loam, clay	CL	A-6, A-7	0	95-100	90-100	85-95	75-90	35-45	NP
	14	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
128*:											
Shingle---------	0-4	Clay loam--------	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-18	Clay loam--------	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
129*:											
Samday----------	0-2	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	75-90	35-50	15-30
	2-18	Clay-------------	CL, CH	A-6	0	100	95-100	85-100	75-95	40-55	20-30
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Shingle---------	0-4	Clay loam--------	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-18	Clay loam--------	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Worf------------	0-2	Fine sandy loam	SM	A-4	0	100	95-100	70-95	35-45	---	NP
	2-18	Sandy clay loam	CL	A-6	0	100	95-100	65-85	60-75	25-40	10-20
	18	Weathered bedrock	---	---	---	---	---	---	---	---	---
130*:											
Sear------------	0-2	Loam-------------	CL, CL-ML	A-6, A-4	0	75-100	75-100	65-80	60-70	25-40	5-15
	2-9	Channery loam	CL, CL-ML, GC, GM-GC	A-6, A-4	0	55-75	55-75	50-65	40-55	25-40	5-15
	9-60	Fragmental material.	GP	A-1	10-25	0-10	0-10	0-5	0-5	---	NP
Wibaux----------	0-4	Channery loam----	GM-GC, SM-SC	A-4	0-5	55-75	50-70	40-60	35-45	25-35	5-10
	4-11	Extremely channery loam.	GM-GC	A-2	0-25	30-55	25-50	20-35	20-30	25-35	5-10
	11-60	Fragmental material.	GP	A-1	0-25	0-10	0-5	0-5	0-5	---	NP
131*:											
Shingle---------	0-4	Clay loam--------	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-13	Clay loam--------	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
Samday----------	0-2	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	75-90	35-50	15-30
	2-18	Clay-------------	CL, CH	A-6	0	100	95-100	85-100	75-95	40-55	20-30
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
132*:											
Shingle---------	0-2	Loam-------------	ML	A-4	0-5	75-100	75-100	70-95	55-75	25-35	NP-10
	2-9	Clay loam--------	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tassel----------	0-2	Loamy fine sand	SM	A-2	0	95-100	90-100	65-95	15-30	---	NP
	2-8	Sandy loam-------	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
133*:											
Shingle	0-4	Clay loam	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-18	Clay loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Theedle	0-5	Loam	CL-ML	A-4	0	95-100	95-100	70-85	60-70	20-30	5-10
	5-28	Loam, clay loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	70-85	60-70	25-40	5-20
	28	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cambria	0-4	Sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	4-8	Loam	CL-ML, ML	A-4	0	95-100	95-100	75-85	60-70	20-30	NP-10
	8-60	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	25-40	5-15
134*:											
Silhouette	0-2	Clay loam	CL	A-6, A-7	0	90-100	90-100	85-95	75-90	35-50	15-30
	2-22	Clay	CL, CH	A-7	0	100	95-100	85-100	85-95	40-55	20-35
	22-60	Clay loam, clay	CL	A-6, A-7	0	100	95-100	85-100	75-95	35-50	15-30
Heldt	0-1	Clay loam	CL	A-7, A-6	0	95-100	95-100	95-100	75-95	35-45	20-30
	1-60	Clay	CH, CL	A-7	0	95-100	95-100	95-100	75-95	45-55	25-35
135*:											
Tassel	0-3	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	75-100	40-65	<35	NP-7
	3-14	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Shingle	0-4	Clay loam	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-18	Clay loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
136*:											
Tassel	0-2	Loamy fine sand	SM	A-2	0	95-100	90-100	65-95	15-30	---	NP
	2-16	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Terro	0-4	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	---	NP
	4-34	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	20-25	NP-5
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
137*:											
Tassel	0-2	Loamy fine sand	SM	A-2	0	95-100	90-100	65-95	15-30	---	NP
	2-16	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tullock	0-5	Loamy sand	SM	A-2	0	100	100	75-90	25-35	---	NP
	5-31	Loamy sand, sand loamy sand, sand.	SM	A-2	0	100	100	70-90	10-35	---	NP
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
137*:											
Vonalee	0-3	Loamy sand	SM	A-2	0	100	95-100	70-90	20-30	---	NP
	3-24	Sandy loam	SM-SC, SM	A-2, A-4	0	100	90-100	55-75	30-40	20-30	NP-10
	24-60	Loamy sand	SM	A-2	0	100	90-100	70-90	20-30	---	NP
138*, 139*:											
Terro	0-4	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	---	NP
	4-34	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	20-25	NP-5
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	
Tullock	0-5	Loamy sand	SM	A-2	0	100	100	75-90	25-35	---	NP
	5-31	Loamy sand, sand	SM	A-2	0	100	100	70-90	10-35	---	NP
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Orpha	0-5	Loamy sand	SM	A-2	0	100	95-100	50-60	20-30	---	NP
	5-60	Sand	SM	A-2	0	100	95-100	60-80	15-35	---	NP
140*, 141*:											
Theedle	0-5	Loam	CL-ML	A-4	0	95-100	95-100	70-85	60-70	20-30	5-10
	5-28	Loam, clay loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	70-85	60-70	25-40	5-20
	28	Weathered bedrock	---	---	---	---	---	---	---	---	---
Kishona	0-3	Loam	ML	A-4	0	85-100	75-100	65-85	55-75	25-30	NP-5
	3-60	Clay loam	CL-ML, CL	A-4, A-6	0	85-100	75-100	70-90	65-85	20-30	5-15
142*:											
Ulm	0-4	Clay loam	CL	A-6	0-5	95-100	95-100	80-100	70-80	30-40	10-20
	4-17	Clay loam, clay	CL	A-6, A-7	0-5	75-100	75-100	75-100	60-80	35-45	20-30
	17-60	Clay loam	CL	A-6	0-5	75-100	75-100	75-100	60-80	30-40	15-20
Bidman	0-7	Sandy loam	SM	A-2, A-4	0	80-100	80-100	50-75	30-40	---	NP
	7-20	Clay	CH	A-7	0	80-100	80-100	80-100	70-90	50-60	30-40
	20-60	Clay loam	CL	A-6, A-7	0	80-100	80-100	75-100	65-80	35-45	20-30
143*:											
Ulm	0-5	Loam	CL-ML	A-4	0-5	95-100	95-100	80-100	70-80	20-30	5-10
	5-21	Clay loam, clay	CL	A-6, A-7	0-5	75-100	75-100	75-100	60-80	35-45	20-30
	21-36	Clay loam	CL	A-6	0-5	75-100	75-100	75-100	60-80	30-40	15-20
	36-60	Sandy clay loam	CL, SC	A-6	0-5	75-100	75-100	70-90	40-55	30-40	10-20
Renohill	0-5	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-80	35-55	20-25	NP-5
	5-20	Clay	CL, CH	A-7, A-6	0	95-100	90-100	90-100	75-95	35-65	20-35
	20-36	Clay loam	CL	A-6	0	85-100	80-100	80-95	70-80	30-40	15-25
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
144*:											
Ulm	0-4	Clay loam	CL	A-6	0-5	95-100	95-100	80-100	70-80	30-40	10-20
	4-16	Clay loam	CL	A-6, A-7	0-5	75-100	75-100	75-100	60-80	35-45	20-30
	16-60	Clay loam	CL	A-6	0-5	75-100	75-100	75-100	60-80	30-40	15-20
Renohill	0-5	Clay loam	CL	A-6	0	85-100	80-100	80-95	70-90	30-40	10-20
	5-25	Clay loam	CL	A-6	0	85-100	80-100	80-95	70-80	30-40	15-25
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
145 Ustic Torriorthents	0-60	Variable	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
146*:											
Vonalee	0-4	Loamy sand	SM	A-2	0	100	95-100	70-90	20-30	---	NP
	4-24	Sandy loam	SM-SC, SM	A-2, A-4	0	100	90-100	55-75	30-40	20-30	NP-10
	24-44	Loamy sand	SM	A-2	0	100	90-100	70-90	20-30	---	NP
	44-60	Sandy loam	SM	A-2, A-4	0	100	95-100	60-90	30-45	---	NP
Terro	0-4	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	---	NP
	4-34	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	20-25	NP-5
	34	Unweathered bedrock	---	---	---	---	---	---	---	---	---
147*:											
Vonalee	0-4	Loamy sand	SM	A-2	0	100	95-100	70-90	20-30	---	NP
	4-24	Sandy loam	SM-SC, SM	A-2, A-4	0	100	90-100	55-75	30-40	20-30	NP-10
	24-60	Loamy sand, loam	SM	A-2	0	100	90-100	70-90	20-30	---	NP
Terro	0-4	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	---	NP
	4-34	Sandy loam	SM	A-2, A-4	0-15	100	100	60-90	30-45	20-25	NP-5
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
148*:											
Wibaux	0-4	Channery loam	GM-GC, SM-SC	A-4	0-5	55-75	50-70	40-60	35-45	25-35	5-10
	4-11	Extremely channery loam.	GM-GC	A-2	0-25	30-55	25-50	20-35	20-30	25-35	5-10
	11-60	Fragmental material.	GP	A-1	0-25	0-10	0-5	0-5	0-5	---	NP
Rock outcrop.											
Shingle	0-4	Clay loam	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-13	Clay loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
149*:											
Worf	0-5	Loamy sand	SM	A-2	0	100	95-100	70-90	20-30	---	NP
	5-15	Clay loam	CL	A-6	0	100	95-100	65-85	60-75	25-40	10-20
	15	Weathered bedrock	---	---	---	---	---	---	---	---	---
Shingle	0-4	Clay loam	CL	A-6	0-5	75-100	70-100	65-100	50-80	35-40	15-20
	4-18	Clay loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tassel	0-3	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	75-100	40-65	<35	NP-7
	3-14	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
150*:											
Zigweid	0-2	Loam	CL	A-6	0	75-100	75-100	70-85	60-70	25-40	10-20
	2-60	Clay loam	CL	A-6	0	75-100	75-100	70-85	60-70	25-40	10-20
Bahl	0-4	Clay	CL	A-6, A-7	0	100	95-100	85-100	60-80	35-45	15-25
	4-60	Clay	CL, CH	A-7	0	100	100	90-100	85-95	40-60	20-35

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
151*:											
Zigweid	0-3	Clay loam	CL	A-6	0	75-100	75-100	70-85	60-70	25-40	10-20
	3-60	Clay loam	CL	A-6	0	75-100	75-100	70-85	60-70	25-40	10-20
Cambria	0-2	Fine sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	2-60	Clay loam, sandy clay loam, loam.	CL-ML, CL	A-4, A-6	0	95-100	95-100	75-85	55-75	25-40	5-15
152*:											
Zigweid	0-4	Loam	CL	A-6	0	75-100	75-100	70-85	60-70	25-40	10-20
	4-60	Clay loam	CL	A-6	0	75-100	75-100	70-85	60-70	25-40	10-20
Cambria	0-4	Sandy loam	SM	A-4	0	95-100	95-100	60-80	35-45	20-25	NP-5
	4-8	Loam	CL-ML, ML	A-4	0	95-100	95-100	75-85	60-70	20-30	NP-10
	8-60	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	25-40	5-15
Theedle	0-5	Loam	CL-ML	A-4	0	95-100	95-100	70-85	60-70	20-30	5-10
	5-28	Loam, clay loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	70-85	60-70	25-40	5-20
	28	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
101*:											
Absted	0-3	8-18	2.0-6.0	0.11-0.13	6.6-7.8	<2	Low	0.32	5	3	1-2
	3-60	35-50	0.06-0.2	0.11-0.13	>7.8	>16	High	0.55			
Arvada	0-3	15-27	0.6-2.0	0.16-0.18	6.6-9.0	<4	Low	0.32	5	5	.5-1
	3-22	40-60	<0.06	0.07-0.09	>7.8	2-8	High	0.32			
	22-60	40-45	0.06-0.2	0.09-0.11	>7.8	<4	High	0.32			
Bone	0-2	27-35	0.6-2.0	0.16-0.18	6.6-7.8	<2	Moderate	0.32	5	5	<.5
	2-5	35-40	<0.06	0.12-0.15	>7.8	2-8	High	0.37			
	5-60	35-50	<0.06	0.08-0.10	>7.8	4-16	High	0.43			
102	0-8	30-40	<0.06	0.15-0.20	6.6-9.0	<2	High	0.32	5	6	2-4
Aeric Haplaquepts	8-60	40-60	<0.06	0.14-0.17	6.6-9.0	<2	High	0.32			
103*:											
Bahl	0-4	40-45	0.06-0.2	0.17-0.20	6.6-8.4	<2	Moderate	0.32	5	6	1-2
	4-60	40-55	0.06-0.2	0.15-0.20	7.4-9.0	2-4	High	0.37			
Savageton	0-2	35-40	<0.06	0.15-0.20	6.6-8.4	<2	High	0.32	2	6	1-2
	2-32	40-50	<0.06	0.15-0.20	7.9-9.0	<2	High	0.37			
	32	---	---	---	---	---	---	---			
104*:											
Cambria	0-2	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low	0.32	5	3	1-2
	2-10	20-35	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.37			
	10-60	18-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
Cushman	0-4	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low	0.32	2	5	1-2
	4-15	27-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	15-33	20-35	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
	33	---	---	---	---	---	---	---			
105*:											
Cambria	0-4	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low	0.32	5	3	1-2
	4-8	10-25	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low	0.37			
	8-60	18-27	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.37			
Cushman	0-3	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low	0.32	2	5	1-2
	3-17	27-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	17-25	20-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
	25	---	---	---	---	---	---	---			
106*:											
Cambria Variant	0-2	5-15	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low	0.32	5	3	1-2
	2-16	20-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	16-60	15-30	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.37			
Forkwood Variant	0-3	27-35	0.6-2.0	0.17-0.20	6.6-7.8	<2	Moderate	0.32	5	6	1-2
	3-16	27-35	0.6-2.0	0.17-0.20	6.6-7.8	<2	Moderate	0.37			
	16-60	10-27	0.6-2.0	0.14-0.20	7.4-8.4	<2	Moderate	0.37			
107*:											
Clarkelen	0-3	5-15	2.0-6.0	0.12-0.14	7.4-8.4	<2	Low	0.24	5	3	1-2
	3-60	5-18	2.0-6.0	0.12-0.15	7.4-9.0	<4	Low	0.28			
Draknab	0-2	0-10	6.0-20	0.07-0.09	7.4-8.4	2-4	Low	0.20	5	2	.5-1
	2-60	0-10	6.0-20	0.06-0.09	7.4-9.0	2-4	Low	0.15			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
108*:											
Clarkelen-------	0-3	5-15	2.0-6.0	0.12-0.14	7.4-8.4	<2	Low-------	0.24	5	3	1-2
	3-60	5-18	2.0-6.0	0.12-0.15	7.4-9.0	<4	Low-------	0.28			
Dwyer-----------	0-5	3-8	6.0-20	0.08-0.11	6.1-9.0	<2	Low-------	0.32	5	2	1-3
	5-60	1-8	6.0-20	0.04-0.11	7.9-9.0	<2	Low-------	0.32			
Orpha-----------	0-5	5-10	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.17	5	2	1-2
	5-60	3-8	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.28			
109*:											
Clarkelen-------	0-3	5-15	2.0-6.0	0.12-0.14	7.4-8.4	<2	Low-------	0.24	5	3	1-2
	3-60	5-18	2.0-6.0	0.12-0.15	7.4-9.0	<4	Low-------	0.28			
Haverdad--------	0-6	5-20	0.6-2.0	0.13-0.15	7.4-9.0	<8	Low-------	0.28	5	3	1-2
	6-60	20-35	0.6-2.0	0.16-0.18	7.9-9.0	<8	Low-------	0.37			
Bigwinder-------	0-3	5-15	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28	5	3	2-4
	3-60	5-20	0.6-6.0	0.12-0.16	7.4-8.4	<2	Low-------	0.32			
110*:											
Cushman---------	0-4	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low-------	0.32	2	5	1-2
	4-15	27-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	15-33	20-35	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
	33	---	---	---	---	---	----------	----			
Terro-----------	0-4	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	4-23	10-18	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28			
	23-34	10-18	2.0-6.0	0.12-0.14	7.4-8.4	<2	Low-------	0.32			
	34	---	---	---	---	---	----------	----			
111*:											
Cushman---------	0-3	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low-------	0.32	2	5	1-2
	3-17	27-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	17-25	20-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
	25	---	---	---	---	---	----------	----			
Terro-----------	0-4	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	4-23	10-18	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28			
	23-34	10-18	2.0-6.0	0.12-0.14	7.4-8.4	<2	Low-------	0.32			
	34	---	---	---	---	---	----------	----			
112*:											
Cushman---------	0-3	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low-------	0.32	2	5	1-2
	3-17	27-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	17-25	20-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
	25	---	---	---	---	---	----------	----			
Worf------------	0-2	10-15	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.28	2	3	1-3
	2-18	20-35	0.6-2.0	0.19-0.21	6.6-8.4	<2	Moderate	0.37			
	18	---	---	---	---	---	----------	----			
113*:											
Dwyer-----------	0-5	3-8	6.0-20	0.08-0.11	6.1-9.0	<2	Low-------	0.32	5	2	1-3
	5-60	1-8	6.0-20	0.04-0.11	7.9-9.0	<2	Low-------	0.32			
Orpha-----------	0-6	5-10	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.17	5	2	1-2
	6-60	3-8	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.28			
114*:											
Forkwood--------	0-7	10-20	2.0-6.0	0.13-0.15	6.6-8.4	2-4	Low-------	0.24	5	3	1-2
	7-60	27-30	0.6-2.0	0.19-0.21	6.6-8.4	2-4	Moderate	0.32			
Cambria---------	0-2	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32	5	3	1-2
	2-10	20-35	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.37			
	10-60	18-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
115*:											
Forkwood--------	0-5	10-20	2.0-6.0	0.13-0.15	6.6-8.4	2-4	Low-------	0.24	5	3	1-2
	5-18	27-35	0.6-2.0	0.19-0.21	6.6-8.4	2-4	Moderate	0.32			
	25-60	20-27	0.6-2.0	0.16-0.18	7.9-9.0	2-4	Low-------	0.28			
Cambria---------	0-4	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32	5	3	1-2
	4-8	10-25	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low-------	0.37			
	8-60	18-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
Cushman---------	0-3	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low-------	0.32	2	5	1-2
	3-17	27-35	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37			
	17-25	20-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
	25	---	---	---	---	---	----------	----			
116*:											
Forkwood--------	0-7	10-20	2.0-6.0	0.13-0.15	6.6-8.4	2-4	Low-------	0.24	5	3	1-2
	7-60	27-30	0.6-2.0	0.19-0.21	6.6-8.4	2-4	Moderate	0.32			
Ulm---------------	0-5	20-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low-------	0.32	5	6	1-3
	5-21	35-50	0.06-2.0	0.19-0.21	6.6-8.4	<2	High------	0.37			
	21-36	30-40	0.6-2.0	0.19-0.21	7.9-9.0	<2	Moderate	0.37			
	36-60	25-35	0.6-2.0	0.12-0.15	7.9-9.0	<2	Moderate	0.37			
117*:											
Forkwood--------	0-7	10-20	2.0-6.0	0.13-0.15	6.6-8.4	2-4	Low-------	0.24	5	3	1-2
	7-60	27-30	0.6-2.0	0.19-0.21	6.6-8.4	2-4	Moderate	0.32			
Ulm---------------	0-4	28-35	0.6-2.0	0.16-0.18	6.6-7.8	<2	Moderate	0.32	5	6	1-3
	4-16	35-40	0.06-2.0	0.19-0.21	6.6-8.4	<2	High------	0.37			
	16-60	30-40	0.6-2.0	0.19-0.21	7.9-9.0	<2	Moderate	0.37			
Renohill--------	0-5	27-35	0.2-0.6	0.17-0.21	6.6-7.8	<2	Moderate	0.37	3	6	1-3
	5-25	30-40	0.2-0.6	0.19-0.21	7.9-9.0	<4	Moderate	0.37			
	25	---	---	---	---	---	----------	----			
118*:											
Gateridge-------	0-4	5-10	6.0-20	0.11-0.13	6.6-7.8	<2	Low-------	0.10	1	2	1-2
	4-11	20-35	0.6-2.0	0.13-0.15	6.6-7.8	<2	Moderate	0.24			
	11-16	40-50	0.06-0.2	0.19-0.21	6.6-7.8	<2	High------	0.37			
	16	---	---	---	---	---	----------	----			
Tassel Variant--	0-4	5-15	2.0-6.0	0.13-0.17	6.6-7.8	<2	Low-------	0.32	1	3	1-2
	4-9	5-20	0.6-2.0	0.11-0.18	7.4-8.4	<2	Low-------	0.37			
	9	---	---	---	---	---	----------	----			
119*. Gullied land											
120*:											
Haverdad--------	0-6	5-20	0.6-2.0	0.13-0.15	7.4-9.0	<8	Low-------	0.28	5	3	1-2
	6-60	20-35	0.6-2.0	0.16-0.18	7.9-9.0	<8	Low-------	0.37			
Lohmiller-------	0-3	30-40	0.06-0.6	0.14-0.17	6.6-8.4	<4	Moderate	0.32	5	4L	1-3
	3-60	35-50	0.06-0.6	0.14-0.16	7.4-8.4	<8	High------	0.32			
121*:											
Hiland----------	0-5	8-18	6.0-20	0.07-0.12	6.6-8.4	<2	Low-------	0.20	5	3	1-2
	5-30	15-25	0.6-2.0	0.12-0.15	7.9-9.0	<4	Low-------	0.28			
	30-60	8-16	2.0-6.0	0.07-0.14	7.9-9.0	<4	Low-------	0.20			
Bowbac----------	0-3	5-15	0.6-2.0	0.12-0.14	6.6-8.4	---	Low-------	0.32	2	3	1-2
	3-18	20-35	0.6-2.0	0.14-0.16	7.4-8.4	<2	Moderate	0.37			
	18-36	15-20	0.6-2.0	0.12-0.17	7.9-9.0	<2	Low-------	0.37			
	36	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
122*:											
Hiland----------	0-3	20-25	2.0-6.0	0.13-0.15	6.6-8.4	<2	Moderate	0.24	5	5	1-2
	3-60	20-35	0.6-2.0	0.14-0.16	6.6-8.4	<2	Moderate	0.28			
Bowbac----------	0-3	5-15	0.6-2.0	0.12-0.14	6.6-8.4	---	Low-------	0.32	2	3	1-2
	3-18	20-35	0.6-2.0	0.14-0.16	7.4-8.4	<2	Moderate	0.37			
	18-36	15-20	0.6-2.0	0.12-0.17	7.9-9.0	<2	Low-------	0.37			
	36	---	---	---	---	---	----------	----			
123*:											
Keeline---------	0-8	5-15	2.0-6.0	0.12-0.14	6.6-8.4	<4	Low-------	0.24	5	3	1-2
	8-60	5-18	2.0-6.0	0.09-0.14	7.9-9.0	<4	Low-------	0.28			
Tassel----------	0-2	2-8	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17	2	2	.5-1
	2-16	5-12	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24			
	16	---	---	---	---	---	----------	----			
Turnback--------	0-4	0-5	2.0-20	0.08-0.10	7.4-8.4	<2	Low-------	0.32	2	2	1-2
	4-30	5-15	2.0-6.0	0.12-0.14	7.4-8.4	<2	Low-------	0.37			
	30	---	---	---	---	---	----------	----			
124*:											
Kishona---------	0-3	10-27	0.6-2.0	0.16-0.18	7.4-8.4	<4	Low-------	0.28	5	4L	.5-1
	3-60	27-35	0.6-2.0	0.10-0.17	7.9-9.0	2-8	Moderate	0.32			
Dwyer-----------	0-5	3-8	6.0-20	0.08-0.11	6.1-9.0	<2	Low-------	0.32	5	2	1-3
	5-60	1-8	6.0-20	0.04-0.11	7.9-9.0	<2	Low-------	0.32			
Orpha-----------	0-5	5-10	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.17	5	2	1-2
	5-60	3-8	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.28			
125*:											
Orella----------	0-4	27-40	0.2-0.6	0.12-0.14	7.4-8.4	<4	High------	0.32	2	4L	.5-1
	4-20	40-65	<0.06	0.09-0.11	7.4-9.0	4-16	High------	0.32			
	20	---	---	---	---	---	----------	----			
Rock outcrop.											
Samday----------	0-2	30-40	0.2-0.6	0.15-0.20	6.6-8.4	<2	High------	0.37	1	6	1-2
	2-18	40-50	0.06-0.2	0.14-0.18	7.4-9.0	<4	High------	0.32			
	18	---	---	---	---	---	----------	----			
126*. Pits											
127*:											
Renohill--------	0-5	8-18	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.28	3	3	1-2
	5-20	40-50	0.06-0.2	0.14-0.16	6.6-8.4	<2	High------	0.32			
	20-36	30-40	0.2-0.6	0.19-0.21	7.9-9.0	<4	Moderate	0.37			
	36	---	---	---	---	---	----------	----			
Worfka----------	0-6	8-18	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	6-18	35-45	0.06-0.2	0.19-0.21	7.4-9.0	<2	Moderate	0.37			
	18	---	---	---	---	---	----------	----			
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-18	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	18	---	---	---	---	---	----------	----			
128*:											
Renohill--------	0-5	27-35	0.2-0.6	0.17-0.21	6.6-7.8	<2	Moderate	0.37	3	6	1-3
	5-25	30-40	0.2-0.6	0.19-0.21	7.9-9.0	<4	Moderate	0.37			
	25	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
128*:											
Worfka----------	0-3	8-18	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	3-14	35-45	0.06-0.2	0.19-0.21	7.4-9.0	<2	Moderate	0.37			
	14	---	---	---	---	---	----------	----			
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-18	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	18	---	---	---	---	---	----------	----			
129*:											
Samday----------	0-2	30-45	0.2-0.6	0.15-0.20	6.6-8.4	<2	High------	0.37	1	6	1-2
	2-18	40-50	0.06-0.2	0.14-0.18	7.4-9.0	<4	High------	0.32			
	18	---	---	---	---	---	----------	----			
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-18	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	18	---	---	---	---	---	----------	----			
Worf----------	0-2	10-15	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.28	2	3	1-3
	2-18	20-35	0.6-2.0	0.19-0.21	6.6-8.4	<2	Moderate	0.37			
	18	---	---	---	---	---	----------	----			
130*:											
Sear----------	0-2	15-35	0.6-2.0	0.13-0.20	6.6-7.8	<2	Low-------	0.32	1	7	1-2
	2-9	18-27	0.6-2.0	0.10-0.13	6.6-8.4	<2	Low-------	0.15			
	9-60	0-2	>20	0.	7.4-8.4	<2	Low-------	0.00			
Wibaux----------	0-4	15-25	0.6-2.0	0.09-0.11	6.6-7.8	<2	Low-------	0.15	1	8	1-3
	4-11	15-25	0.6-2.0	0.04-0.06	6.6-7.8	<2	Low-------	0.15			
	11-60	0	>20	---	---	<2	----------	0.00			
131*:											
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-13	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	13	---	---	---	---	---	----------	----			
Rock outcrop.											
Samday----------	0-2	30-40	0.2-0.6	0.15-0.20	6.6-8.4	<2	High------	0.37	1	6	1-2
	2-18	40-50	0.06-0.2	0.14-0.18	7.4-9.0	<4	High------	0.32			
	18	---	---	---	---	---	----------	----			
132*:											
Shingle---------	0-2	18-27	0.6-2.0	0.16-0.18	7.4-9.0	<2	Low-------	0.32	2	5	1-3
	2-9	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	9	---	---	---	---	---	----------	----			
Rock outcrop----	0-60	---	---	---	---	<2	----------	----	---	---	---
Tassel----------	0-2	2-8	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17	2	2	.5-1
	2-8	5-12	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24			
	8	---	---	---	---	---	----------	----			
133*:											
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-18	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	18	---	---	---	---	---	----------	----			
Theedle---------	0-5	10-20	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-------	0.32	2	5	1-2
	5-28	18-35	0.6-2.0	0.17-0.20	7.4-8.4	<8	Moderate	0.37			
	28	---	---	---	---	---	----------	----			
Cambria---------	0-4	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32	5	3	1-2
	4-8	10-25	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low-------	0.37			
	8-60	18-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
134*:											
Silhouette------	0-2	30-45	0.2-0.6	0.15-0.20	7.4-8.4	<2	High------	0.32	5	6	1-2
	2-22	40-50	0.06-0.2	0.14-0.18	7.4-9.0	<4	High------	0.37			
	22-60	30-45	0.2-0.6	0.15-0.20	7.4-8.4	<2	High------	0.37			
Heldt-----------	0-1	30-40	0.06-0.6	0.12-0.17	7.9-9.0	<8	High------	0.28	5	4	.5-2
	1-60	40-50	0.06-0.6	0.12-0.17	7.9-9.0	<8	High------	0.28			
135*:											
Tassel----------	0-3	5-12	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low-------	0.24	2	3	.5-1
	3-14	5-12	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24			
	14	---	---	---	---	---	----------	----			
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-18	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	18	---	---	---	---	---	----------	----			
136*:											
Tassel----------	0-2	2-8	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17	2	2	.5-1
	2-16	5-12	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24			
	16	---	---	---	---	---	----------	----			
Terro-----------	0-4	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	4-34	10-18	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28			
	34	---	---	---	---	---	----------	----			
Rock outcrop.											
137*:											
Tassel----------	0-2	2-8	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17	2	2	.5-1
	2-16	5-12	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24			
	16	---	---	---	---	---	----------	----			
Tullock---------	0-5	5-10	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17	3	2	1-2
	5-31	0-10	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17			
	31	---	---	---	---	---	----------	----			
Vonalee---------	0-3	0-10	6.0-20	0.07-0.09	6.6-7.8	<2	Low-------	0.24	5	2	1-2
	3-24	5-15	2.0-6.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32			
	24-60	0-10	6.0-20	0.07-0.09	7.4-9.0	<2	Low-------	0.24			
138*, 139*:											
Terro-----------	0-4	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	4-34	10-18	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28			
	34	---	---	---	---	---	----------	----			
Tullock---------	0-5	5-10	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17	3	2	1-2
	5-31	0-10	6.0-20	0.10-0.12	7.4-8.4	<2	Low-------	0.17			
	31	---	---	---	---	---	----------	----			
Orpha-----------	0-5	5-10	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.17	5	2	1-2
	5-60	3-8	>20	0.06-0.07	6.6-7.8	<2	Low-------	0.28			
140*, 141*:											
Theedle---------	0-5	10-20	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-------	0.32	2	5	1-2
	5-28	18-35	0.6-2.0	0.17-0.20	7.4-8.4	<8	Moderate	0.37			
	28	---	---	---	---	---	----------	----			
Kishona---------	0-3	10-27	0.6-2.0	0.16-0.18	7.4-8.4	<4	Low-------	0.28	5	4L	.5-1
	3-60	27-35	0.6-2.0	0.10-0.17	7.9-9.0	2-8	Moderate	0.32			
142*:											
Ulm---------	0-4	28-35	0.6-2.0	0.16-0.18	6.6-7.8	<2	Moderate	0.32	5	6	1-3
	4-17	35-50	0.06-2.0	0.19-0.21	6.6-8.4	<2	High------	0.37			
	17-60	30-40	0.6-2.0	0.19-0.21	7.9-9.0	<2	Moderate	0.37			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
142*:											
Bidman----------	0-7	5-15	0.6-2.0	0.16-0.18	6.1-7.3	<2	Low-------	0.28	5	3	1-2
	7-20	40-50	0.06-0.2	0.14-0.16	6.6-7.8	<2	High------	0.32			
	20-60	27-35	0.2-0.6	0.19-0.21	7.9-9.0	<2	High------	0.43			
143*:											
Ulm---------------	0-5	20-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low-------	0.32	5	6	1-3
	5-21	35-50	0.06-2.0	0.19-0.21	6.6-8.4	<2	High------	0.37			
	21-36	30-40	0.6-2.0	0.19-0.21	7.9-9.0	<2	Moderate	0.37			
	36-60	25-35	0.6-2.0	0.12-0.15	7.9-9.0	<2	Moderate	0.37			
Renohill---------	0-5	8-18	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.28	3	3	1-2
	5-20	40-50	0.06-0.2	0.14-0.16	6.6-8.4	<2	High------	0.32			
	20-36	30-40	0.2-0.6	0.19-0.21	7.9-9.0	<4	Moderate	0.37			
	36	---	---	---	---	---	----------	----			
144*:											
Ulm---------------	0-4	28-35	0.6-2.0	0.16-0.18	6.6-7.8	<2	Moderate	0.32	5	6	1-3
	4-16	40-50	0.06-2.0	0.19-0.21	6.6-8.4	<2	High------	0.37			
	16-60	30-40	0.6-2.0	0.19-0.21	7.9-9.0	<2	Moderate	0.37			
Renohill---------	0-5	27-35	0.2-0.6	0.17-0.21	6.6-7.8	<2	Moderate	0.37	3	6	1-3
	5-25	30-40	0.2-0.6	0.19-0.21	7.9-9.0	<4	Moderate	0.37			
	25	---	---	---	---	---	----------	----			
145---------------	0-60	---	---	---	---	---	----------	----	---	---	---
Ustic Torriorthents											
146*:											
Vonalee----------	0-4	0-10	6.0-20	0.07-0.09	6.6-7.8	<2	Low-------	0.24	5	2	1-2
	4-24	5-15	2.0-6.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32			
	24-44	0-10	6.0-20	0.07-0.09	7.4-9.0	<2	Low-------	0.24			
	44-60	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28			
Terro------------	0-4	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	4-34	10-18	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28			
	34	---	---	---	---	---	----------	----			
147*:											
Vonalee----------	0-3	0-10	6.0-20	0.07-0.09	6.6-7.8	<2	Low-------	0.24	5	2	1-2
	3-24	5-15	2.0-6.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32			
	24-60	0-10	0.6-6.0	0.09-0.14	7.4-9.0	<2	Low-------	0.24			
Terro------------	0-4	8-12	2.0-6.0	0.09-0.14	6.6-7.8	<2	Low-------	0.28	2	3	1-2
	4-34	10-18	2.0-6.0	0.12-0.14	6.6-7.8	<2	Low-------	0.28			
	34	---	---	---	---	---	----------	----			
148*:											
Wibaux-----------	0-4	15-25	0.6-2.0	0.09-0.11	6.6-7.8	<2	Low-------	0.15	1	8	1-3
	4-11	15-25	0.6-2.0	0.04-0.06	6.6-7.8	<2	Low-------	0.15			
	11-60	0	>20	---	---	<2	----------	0.00			
Rock outcrop.											
Shingle----------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-13	27-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	13	---	---	---	---	---	----------	----			
149*:											
Worf-------------	0-5	0-10	6.0-2.0	0.17-0.19	6.6-7.8	<2	Low-------	0.24	1	2	1-2
	5-15	27-35	0.6-2.0	0.19-0.21	6.6-8.4	<2	Moderate	0.37			
	15	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
149*:											
Shingle---------	0-4	27-35	0.6-2.0	0.19-0.21	7.4-9.0	<2	Moderate	0.32	2	6	1-3
	4-18	17-35	0.6-2.0	0.16-0.21	7.4-9.0	<2	Moderate	0.49			
	18	---	---	---	---	---	----------	----			
Tassel----------	0-3	5-12	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low-------	0.24	2	3	.5-1
	3-14	5-12	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24			
	14	---	---	---	---	---	----------	----			
150*:											
Zigweid---------	0-2	18-35	0.6-2.0	0.16-0.21	6.6-8.4	<2	Moderate	0.32	5	6	1-2
	2-60	27-35	0.6-2.0	0.16-0.21	7.9-9.0	<2	Moderate	0.43			
Bahl------------	0-4	40-45	0.06-0.2	0.17-0.20	6.6-8.4	<2	Moderate	0.32	5	6	1-2
	4-60	40-55	0.06-0.2	0.15-0.20	7.4-9.0	2-4	High------	0.37			
151*:											
Zigweid---------	0-3	27-35	0.6-2.0	0.16-0.21	6.6-8.4	<2	Moderate	0.32	5	6	1-2
	3-60	27-35	0.6-2.0	0.16-0.21	7.9-9.0	<2	Moderate	0.43			
Cambria---------	0-2	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32	5	3	1-2
	2-60	18-35	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.37			
152*:											
Zigweid---------	0-4	18-27	0.6-2.0	0.16-0.21	6.6-8.4	<2	Moderate	0.32	5	6	1-2
	4-60	27-35	0.6-2.0	0.16-0.21	7.9-9.0	<2	Moderate	0.43			
Cambria---------	0-4	5-15	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low-------	0.32	5	3	1-2
	4-8	10-25	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low-------	0.37			
	8-60	18-27	0.6-2.0	0.17-0.20	7.9-9.0	<2	Moderate	0.37			
Theedle---------	0-5	10-20	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-------	0.32	2	5	1-2
	5-28	18-35	0.6-2.0	0.17-0.20	7.4-8.4	<8	Moderate	0.37			
	28	---	---	---	---	---	----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
101*:												
Absted	C	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Arvada	D	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Bone	D	None	---	---	>6.0	---	---	>60	---	Low	High	High.
102--- Aeric Haplaquepts	D	None	---	---	0-2.0	Apparent	Mar-Jul	>60	---	Moderate	Moderate	Low.
103*:												
Bahl	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Savageton	D	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
104*, 105*:												
Cambria	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Cushman	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
106*:												
Cambria Variant	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Forkwood Variant	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
107*:												
Clarkelen	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Draknab	A	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
108*:												
Clarkelen	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Dwyer	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Orpha	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
109*:												
Clarkelen	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Haverdad	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Bigwinder	D	Frequent	Brief	Mar-Jun	1.0-3.0	Apparent	Apr-Aug	>60	---	Moderate	High	Low.
110*, 111*:												
Cushman	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Terro	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
112*:												
Cushman	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Worf	D	None	---	---	>6.0	---	---	8-20	Soft	Low	Moderate	Low.
113*:												
Dwyer	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Orpha	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
114*:												
Forkwood	B	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Cambria	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
115*:												
Forkwood	B	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Cambria	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Cushman	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
116*:												
Forkwood	B	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Ulm	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
117*:												
Forkwood	B	None	---	---	>6.0	---	---	>60	---	Low	High	High.

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
117*:												
Ulm	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Renohill	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
118*:												
Gateridge	D	None	---	---	>6.0	---	---	10-20	Soft	Low	Moderate	Low.
Tassel Variant	D	None	---	---	>6.0	---	---	5-10	Soft	Low	High	Low.
119*. Gullied land												
120*:												
Haverdad	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Lohmiller	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
121*, 122*:												
Hiland	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Bowbac	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
123*:												
Keeline	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Tassel	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Turnback	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
124*:												
Kishona	B	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Dwyer	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Crpha	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
125*:												
Orella	D	None	---	---	>6.0	---	---	10-20	Soft	Low	High	Low.
Rock outcrop.												

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
125*:												
Samday	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
126*.												
Pits												
127*, 128*:												
Renohill	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Worfka	D	None	---	---	>6.0	---	---	7-20	Soft	Moderate	High	Low.
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Low.
129*:												
Samday	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Low.
Worf	D	None	---	---	>6.0	---	---	8-20	Soft	Low	Moderate	Low.
130*:												
Sear	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Wibaux	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
131*:												
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Low.
Rock outcrop.												
Samday	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
132*:												
Shingle	D	None	---	---	>6.0	---	---	4-10	Soft	Low	High	Low.
Rock outcrop	D	None	---	---	>6.0	---	---	0	Soft	---	---	---
Tassel	D	None	---	---	>6.0	---	---	5-10	Soft	Low	High	Low.
133*:												
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Low.

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
133*:												
Theedle	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Cambria	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
134*:												
Silhouette	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Heldt	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
135*:												
Tassel	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Low.
136*:												
Tassel	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Terro	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Rock outcrop.												
137*:												
Tassel	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Tullock	C	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Vonalee	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
138*, 139*:												
Terro	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Tullock	C	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Orpha	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
140*, 141*:												
Theedle	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Kishona	B	None	---	---	>6.0	---	---	>60	---	Low	High	High.
142*:												
Ulm	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
142*:												
Bidman	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
143*, 144*:												
Ulm	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Renohill	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
145	-	None	---	---	>6.0	---	---	>60	---	---	---	---
Ustic Torriorthents												
146*, 147*:												
Vonalee	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Terro	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
148*:												
Wibaux	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Rock outcrop.												
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	HIgh	Low.
149*:												
Worf	D	None	---	---	>6.0	---	---	8-20	Soft	Low	Moderate	Low.
Shingle	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Low.
Tassel	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
150*:												
Zigweid	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Bahl	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
151*:												
Zigweid	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Cambria	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
152*:												
Zigweid	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Cambria	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Theedle	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Absted	Fine, montmorillonitic, mesic Haplustollic Natrargids
Aeric Haplaquepts	Aeric Haplaquepts
Arvada	Fine, montmorillonitic, mesic Ustollic Natrargids
Bahl	Fine, montmorillonitic (calcareous), mesic Ustertic Torriorthents
Bidman	Fine, montmorillonitic, mesic Ustollic Paleargids
Bigwinder	Coarse-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Fluvaquents
Bone	Fine, montmorillonitic (calcareous), mesic Ustic Torriorthents
Bowbac	Fine-loamy, mixed, mesic Ustollic Haplargids
Cambria	Fine-loamy, mixed, mesic Ustollic Haplargids
Cambria Variant	Fine loamy, mixed, mesic Ustollic Haplargids
Clarkelen	Coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Cushman	Fine-loamy, mixed, mesic Ustollic Haplargids
Draknab	Sandy, mixed, mesic Ustic Torrifluvents
Dwyer	Mixed, mesic Ustic Torripsamments
Forkwood	Fine-loamy, mixed, mesic Ustollic Haplargids
Forkwood Variant	Fine-loamy, mixed, mesic Ustollic Haplargids
Gateson Variant	Mixed, shallow typic eutroboralfs Loamy
Haverdad	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Heldt	Fine, montmorillonitic, mesic Ustertic Camborthids
Hiland	Fine-loamy, mixed, mesic Ustollic Haplargids
Keeline	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Kishona	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Lohmiller	Fine, montmorillonitic (calcareous), mesic Ustic Torrifluvents
Orella	Clayey, mixed (calcareous), mesic, shallow Ustic Torriorthents
Orpha	Mixed, mesic Ustic Torripsamments
Renohill	Fine, montmorillonitic, mesic Ustollic Haplargids
Rock outcrop.	
Samday	Clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents
Savageton	Fine, montmorillonitic, mesic Ustollic Camborthids
Sear	Fine-loamy over fragmental, mixed, mesic Ustollic Haplargids
Shingle	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Silhouette	Fine, montmorillonitic, mesic Ustollic Camborthids
Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Tassel Variant	Loamy, mixed, (calcareous), mesic, shallow Typic Ustorthents
Terro	Coarse-loamy, mixed, mesic Ustollic Haplargids
Theedle	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Tullock	Mixed, mesic Ustic Torripsamments
Turnback	Coarse-loamy, mixed, mesic Ustollic Camborthids
Ulm	Fine, montmorillonitic, mesic Ustollic Haplargids
Ustic Torriorthents	Reclaimed Ustic Torriorthents
Vonalee	Coarse-loamy, mixed, mesic Ustollic Haplargids
Wibaux	Loamy-skeletal over fragmental, mixed, nonacid, mesic Ustic Torriorthents
Worf	Loamy, mixed, mesic, shallow Ustollic Haplargids
Worfka	Clayey, montmorillonitic, mesic, shallow Ustollic Haplargids
Zigweid	Fine-loamy, mixed, mesic Ustollic Camborthids

☆ U.S. GOVERNMENT PRINTING OFFICE : 1986 O - 493-545 : QL 3

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.