

USDA United States
Department of
Agriculture

Natural
Resources
Conservation
Service

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

Soil Survey of Albany County Area, Wyoming



How to Use This Soil Survey

General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

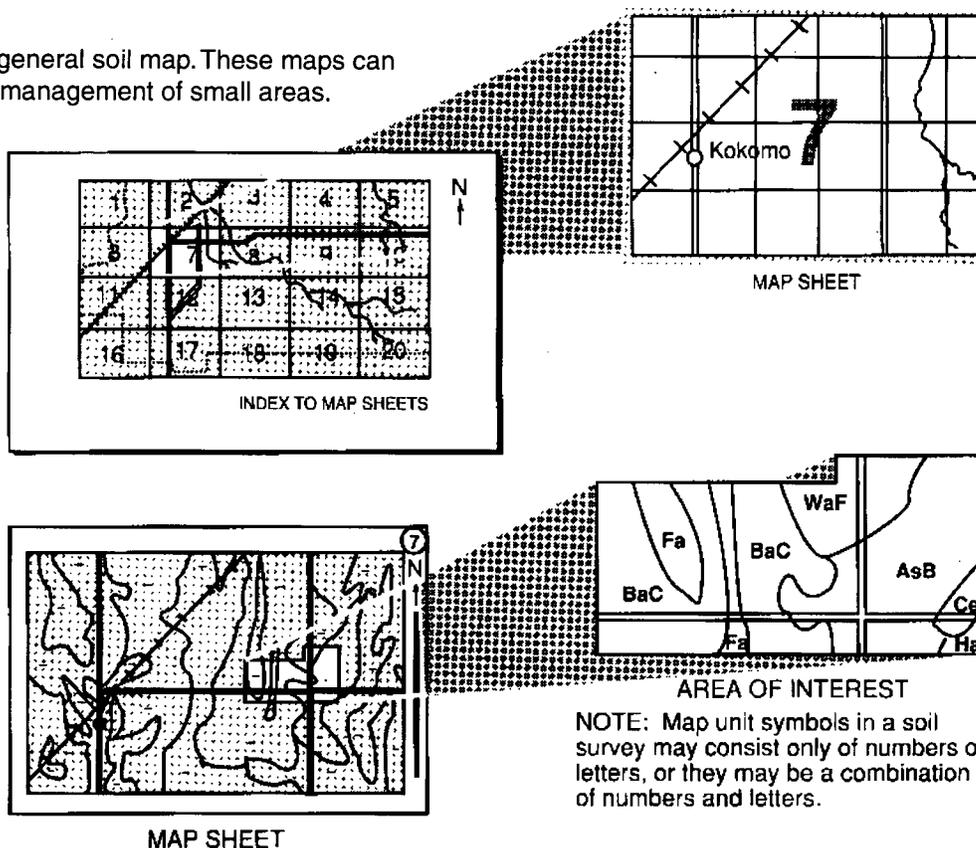
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map units symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.



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 Natural Resources Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Natural Resources Conservation Service, University of Wyoming Agricultural Experiment Station, U.S. Bureau of Land Management, and the U.S. Forest Service. The Albany County Board of Commissioners, the City of Laramie, and the Laramie Rivers Conservation District provided financial assistance for the survey. It is part of the technical assistance furnished to the Laramie Rivers Conservation District. The Albany County Board of Commissioners, the City of Laramie, and the Laramie Rivers Conservation District provided financial assistance for the survey. The survey is part of the technical assistance furnished to the Laramie Rivers 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.

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Cover: An aerial view of the city of Laramie as viewed from east of the city. Much of the city is on the Wycolo-Tieside-Fiveoh general soil map unit. The mountains in the background are on the general soil map unit of Rogert-Granile-Rock outcrop.

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Issued 1998

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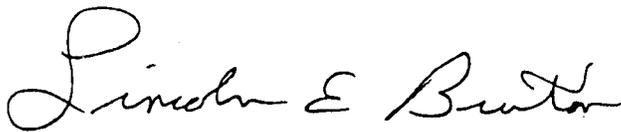
Foreword

This soil survey contains information that can be used in land-planning programs in Albany County, Wyoming. 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 Natural Resources Conservation Service or the Cooperative Extension Service.



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Soil Survey of Albany County Area, Wyoming

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United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the University of Wyoming Agricultural Experiment Station, United States Forest Service, and United States Department of the Interior, Bureau of Land Management

The Albany County Area is comprised of Albany County, excluding the portion of the county within the Laramie Peak and Main Bow Districts of the Medicine Bow National Forest (fig. 1). The area is about 3,593 square miles, or 2,320,491 acres. The survey area includes the 60,000 acre Pole Mountain District of the Medicine Bow National Forest. About 335,000 acres of the survey area, mostly northeast of Rock River, is administered by the Bureau of Land Management.

General Nature of the Survey Area

This section provides general information about the survey area. It describes history, physiography and drainage, geology, and climate.

The 1980 census lists a population of 29,062 for Albany County and 24,410 for the City of Laramie, which is the county seat. The University of Wyoming is in Laramie, and the Union Pacific Railroad maintains large rail yards there. Rock River had 1980 census of 415. The smaller communities in the survey area include Albany, Bosler, Mountain Home, Tie Siding, and Woods Landing.

Most of the survey area is rangeland, and cattle ranches are the dominant agricultural enterprise. About 4.2 percent of the survey area, or 97,000 acres, is irrigated hay and pasture. There are numerous fishing and recreational lakes and streams in the county. Pronghorn

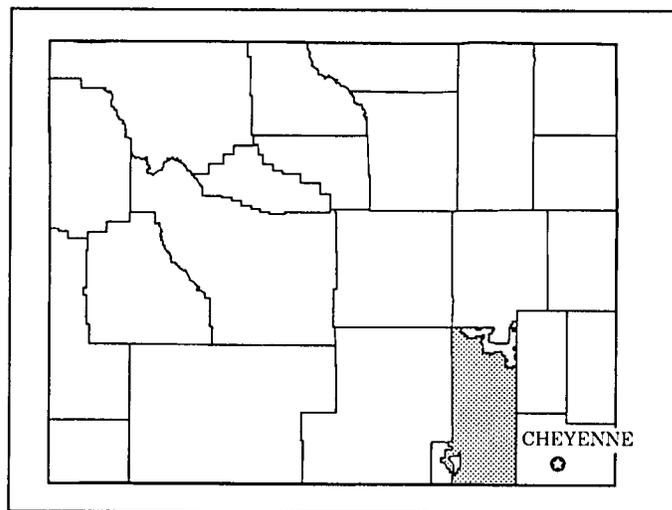


Figure 1.—Location of Albany County Area in Wyoming.

antelope, whitetail and mule deer, and elk are fairly common in the area. Fishing, hunting, and tourism are very important to the local economy. Oil production is important in a few areas.

Albany County has two Federal wildlife refuges administered by the Fish and Wildlife Service: Hutton Lake southwest of Laramie, and Bamforth Lake northwest of Laramie.

History

The Overland Trail crosses the south end of the Laramie Plains from southeast to west. It closely follows the route of the older Cherokee Trail used during the migration of the Cherokee tribe to California.

The Arapaho, Cheyenne, and Sioux tribes were nomadic inhabitants of the area before white settlement. The Arapaho are representative of the fate that befell the Plains Indian. Along with the Cheyenne, they were given most of southeast Wyoming and northeast Colorado by the Peace Council of Fort Laramie in 1851. After being harassed in Colorado, the Arapaho were given a different area near Casper, Wyoming by authority of the Medicine Lodge Treaty of 1867. Soon thereafter an unsuccessful attempt was made to move them to northwestern Nebraska. Eventually the Arapaho were forced onto the Wind River Reservation in 1878 (Brink, 1986).

The history of Albany County is also closely related to the Union Pacific Railroad, the University of Wyoming, and to the development of natural resources. In 1865, General Grenville Dodge found the "gangplank" route across the Laramie Range east of the present site of Laramie. The following year this route was selected for the trans-continental railroad. Eventually US Highway 30 and Interstate-80 would closely parallel the route.

Fort Sanders was built near Laramie in 1866 for the troops protecting crews surveying for the railroad. After skirmishes with the Sioux and Cheyenne in May of 1867, troops were temporarily stationed at Rock Creek, Cooper Creek, and Sevenmile Creek. The coming of the actual construction crews triggered further raids in the spring of 1868. Army dignitaries such as Generals Phil Sheridan, Ulysses Grant, and William Sheridan visited the Fort in 1868. The Fort was abandoned in 1882 (Murray, 1974). The city of Laramie was started with the arrival of the railroad. Laramie can claim the world's first jury comprised of women, in March of 1870.

The University of Wyoming opened its doors in 1887, three years before statehood was granted to Wyoming Territory. It is the only four-year institution of higher learning in the state. The seven included colleges, as well as the School of Extended Studies and the Graduate School, occupy some 80 buildings on about 780 acres. The University also has four farms and five agricultural experiment stations, which cover about 5,200 acres in various locations throughout the state (Brink, 1986). A few of the unique attractions of the campus include the Rocky Mountain Herbarium, which has about 300,000 plant specimens, and the S.H. Knight Geology Building museum with its extensive rock, mineral, and fossil collections (Wyoming Recreation Commission, 1976).

Much of the land resources were originally used for summer pasture of horses, particularly for the cavalry.

Most of the land was eventually used for cattle grazing. During the first decade of this century, large irrigation projects were started for the production of hay. An example is the Pioneer Canal, which has been operating for about 80 years. Extensive land developments for veterans were attempted after World War I. Many crops met with limited success due to the cool climate and somewhat short growing season.

Energy development and mining are only slightly less prominent in the history of the area. Titanium was mined in the Laramie Range; gold, silver, and copper are examples of minerals developed in the Medicine Bow Range. Herrick Dome and Quealy Dome west of Laramie are examples of currently producing oil fields. The Wyoming Geological Survey has explored the Laramie Range for kimberlite pipes, a source of diamonds.

Physiography and Drainage

Albany County is at the northern end of the southern Rocky Mountains. About one-half of the county is a high, intermontane basin and one-half is mountain ranges. The basin has gently sloping sedimentary beds in its center, and has more steeply sloping beds along the edges and in the foothills. Steeply sloping mountains form the Laramie Range east of Laramie and the Medicine Bow Range west of Laramie.

Elevations in the survey area range from about 5,150 feet where the Laramie River leaves the county, to 9,656 feet on Jelm Mountain. Local relief ranges from tens of feet to several hundred feet in the Laramie Basin, to one or two thousand feet of relief in the mountains. Although many of the geologic formations in the basin are thought to be millions of years old, most of the existing landforms were made by erosion of and deposition on the old rocks during the past several hundred thousand years. Landforms associated with streams may only be several hundred years old.

Streams flowing through the survey area have their headwaters in the previously mentioned mountain ranges and in the Rawah Range of northern Colorado. These streams are tributaries to the Laramie River which flows into Platte County. The major tributaries are the North Laramie River, Rock Creek, Chugwater Creek, Duck Creek, and Crow Creek.

Geology

The earth is currently thought to have formed some 4.5 billion years ago. Very little is known about the geology of Wyoming from this beginning until about 500 million years ago.

Beginning about 500 million years ago and lasting about 200 million years, the state was subject to several

periods of marine invasion by a shallow warm sea. About 300 million years ago, a crustal uplift occurred in many parts of North America, including Colorado and Wyoming. The ancestral Rocky Mountains were formed in Colorado, elevating the southeastern part of Wyoming. This increase in elevation caused accelerated erosion in areas exposed above sea level. The fluctuating shoreline of the warm sea continued to cover portions of Wyoming for another 235 million years, until about 65 million years ago.

Widespread coastal uplift, along with folding and faulting, raised Wyoming entirely above sea level at this time. This episode of mountain building, commonly known as the Laramide Orogeny, lasted about 8 million years. It created large ridges and hills in the marine sediments. With time, these sediments eroded away and exposed the older igneous and metamorphic rocks. Today these rocks form the Medicine Bow and Laramie mountain ranges.

Intense volcanic activity began in Wyoming about 40 million years ago. The volcanoes, located mainly in the Yellowstone area, covered much of the state and surrounding areas with great depths of debris and were active for over 35 million years. It is believed that only the highest mountain tops were not covered.

The interior of the North American continent was uplifted to its present elevation between 3 and 6 million years ago. Due to a different climate caused by the higher elevation and the Ice Age extreme erosion occurred. In a span of some 3 million years, most of the volcanic sediments were eroded away and the marine sedimentary formations were exhumed.

Most of the stable landforms present in the basin today were created during the past tens or hundreds of thousands of years by glacial outwash waters. Sedimentary formations were beveled by water and then covered with relatively thin veneers of cobbly and gravelly alluvium. These deposits are thicker and contain larger coarse fragments in the areas closest to the mountain sources.

Climate

Tables 1a, 1b, and 1c give data on temperature and precipitation for three stations in the survey area. Tables 2a, 2b, and 2c show probable dates of the first freeze in fall and the last freeze in spring. Tables 3a, 3b, and 3c provide data on length of the growing season.

In winter, the average temperature as recorded at the Laramie Airport is 23.5 degrees F and the average daily minimum temperature is 11.6 degrees. The lowest temperature recorded at the station is 50 degrees below zero. In summer, the average temperature is 61 degrees and the average daily maximum temperature is 76.9 degrees. The highest temperature recorded at this station is 95 degrees.

Growing degree days are shown in tables 1a, 1b, and 1c. 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 as recorded at the Laramie Airport is 10.85 inches. Of this, 6.46 inches, or 60 percent, usually falls in May through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in May through September is less than 2.9 inches. The average seasonal snowfall is 47.5 inches.

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; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They 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 biological 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 a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into 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 a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret 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 are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on hay yields under defined levels of management are 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 predict with a fairly high degree of accuracy 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 in the soil 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 accurately.

The general procedures used to make this soil survey are described in the Natural Resources Conservation Service Soil Survey Manual (U.S. Dep. Agric., 1993). Soil mapping was done on quad centered black and white aerial photos at a scale of 1:24,000. These photos were taken during the period of 1976 to 1979, and correspond to U.S. Geological Survey 7.5 minute topographic maps. The photos were viewed stereoscopically to identify changes in bedrock, slope, and other landscape features. False color infrared aerial photos were used to assist with the identification of land features important in the mapping of the soils.

Observations were made and the soils identified at selected locations on various landform positions. The observation points were spaced from 100 to 1,000 feet apart, depending on the complexity of the landforms. Most of the soil samples were taken with truck-mounted hydraulic probes to a depth of four feet, with some samples taken from a depth of five feet. In areas that were not accessible by truck, traverses were done on foot and the soils were observed by the use of a tile spade and hand auger. Frequency of the traverses was largely dependent of the size and complexity of the landforms, but averaged about two or three per section of land in smooth to rolling areas and about one per section of land in steep areas with rough topography. More traverses and more observation points were necessary on irrigated hay fields and pastures because of the more detailed mapping in these areas.

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 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, it 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 another unit 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 ranch or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

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

The General Soil Map of Albany County Area is a part of the State Soil Geographic (STATSGO) data base and general soils map of Wyoming. Map symbols are the same as the STATSGO general soil map units. In each map unit, two or three of the major soils or miscellaneous land types that occur within each map unit are described. More information for the General Soil Map units can be obtained from the STATSGO database available from the Natural Resources Conservation Service.

Map Unit Descriptions

WY131 Boyle-Lininger-Rock Outcrop.

Very shallow to moderately deep, well drained, nearly level to moderately steep soils and Rock outcrop on foothills and mountain slopes.

Slopes are 1 to 25 percent. The average annual precipitation is 15 to 19 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 35 percent Boyle and similar soils, 30 percent Lininger and similar soils, and 20 percent Rock outcrop. The remaining 15 percent consists of components of minor extent.

The Boyle and similar soils are on nearly level to moderately steep foothills and mountain slopes. These soils are very shallow or shallow and well drained. They formed in colluvium and residuum derived from granite. The soils have a gravelly coarse textured surface layer and a gravelly to very gravelly moderately fine textured subsoil. Weakly consolidated bedrock is at a depth of 7 to 20 inches.

The Lininger and similar soils are on nearly level to gently sloping foothills and mountain slopes. These soils are moderately deep and well drained. They formed in alluvium and residuum derived from granite. The soils have a medium textured surface layer, a gravelly moderately fine textured upper part of the subsoil, and a very gravelly moderately fine textured lower part of the subsoil. Weakly consolidated bedrock is at depth of 20 to 40 inches.

The Rock outcrop consists of exposures of granite and gneiss.

Of minor extent in this unit are the very deep, moderately well drained Dalecreek soils and the very deep, poorly drained Kovich soils.

This unit is used mainly as rangeland or for wildlife habitat. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, and Rock outcrop. Some areas of this unit are crucial winter habitat for elk, mule deer, and antelope. A few sage grouse breeding areas occur in this unit.

WY132 Rogert-Rock Outcrop.

Shallow, well drained, gently sloping to very steep soils and Rock outcrop on foothills and mountain slopes.

Slopes are 5 to 99 percent. The average annual precipitation is 15 to 19 inches, the average annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is about 50 percent Rogert and similar soils and 20 percent Rock outcrop. The remaining 30 percent consists of components of minor extent.

The Rogert and similar soils are on gently sloping to very steep foothills and mountain slopes. These soils are shallow and well drained. They formed in colluvium and residuum derived from granite. The soils have a gravelly moderately coarse textured surface layer and a very gravelly moderately coarse textured underlying material. Hard bedrock is at a depth of 10 to 20 inches.

The Rock outcrop consists of exposures of granite.

Of minor extent in this unit on foothills and mountain slopes are the moderately deep Amesmont, Kezar, and Lakehelen soils and the very deep Granile soils. Of minor extent in the valleys of this unit are the very deep, somewhat poorly drained Silas soils and the very deep, poorly drained Vensora soils.

This unit is used mainly as rangeland or for wildlife habitat. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils and by the percentage of Rock outcrop in the unit.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, and Rock outcrop. Some areas of this unit are crucial winter habitat for elk, mule deer, and antelope. A few sage grouse breeding areas occur in this unit.

WY133 Lymanson-Thiel.

Moderately deep or very deep, well drained, gently sloping to moderately steep soils on fan terraces and hills.

Slopes are 5 to 20 percent. The average annual precipitation is 10 to 19 inches, the average annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is about 45 percent Lymanson and similar soils and 35 percent Thiel and similar soils. The remaining 20 percent consists of components of minor extent.

The Lymanson and similar soils are on gently sloping to moderately steep fan terraces and hills. These soils are moderately deep and well drained. They formed in alluvium and residuum derived from sedimentary rocks. The soils have a medium textured surface layer and a

moderately fine textured subsoil. Weakly consolidated bedrock is at a depth of 20 to 40 inches.

The Thiel and similar soils are on gently sloping to moderately steep fan terraces and hills. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a gravelly moderately coarse textured surface layer, a very gravelly moderately fine textured upper part of the subsoil, and a very gravelly moderately coarse textured lower part.

Of minor extent in this unit are the shallow Bucklon soils and the very deep Leavitt soils.

This unit is used mainly as rangeland or for wildlife habitat. This unit has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, and Rock outcrop. Some areas of this unit are crucial winter habitat for mule deer.

WY134 Rogert-Rock Outcrop-Lakehelen.

Shallow or moderately deep, well drained, gently sloping to very steep soils and Rock outcrop on foothills and mountain slopes.

Slopes are 5 to 99 percent. The average annual precipitation is 15 to 19 inches, the average annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is about 40 percent Rogert and similar soils, 20 percent Rock outcrop, and 15 percent Lakehelen and similar soils. The remaining 25 percent consists of components of minor extent.

The Rogert and similar soils are on gently sloping to very steep foothills and mountain slopes. These soils are shallow and well drained. They formed in colluvium and residuum derived from granite. The soils have a gravelly moderately coarse textured surface layer and a very gravelly moderately coarse textured underlying material. Hard bedrock is at a depth of 10 to 20 inches.

The Rock outcrop consists of exposures of granite.

The Lakehelen and similar soils are on gently sloping to steep foothills and mountain slopes. These soils are moderately deep and well drained. They formed in colluvium and residuum derived from granite. The soils have a moderately coarse textured surface layer, a very gravelly moderately fine textured subsoil, and an extremely gravelly moderately coarse textured substratum. Hard granite bedrock is at a depth of 20 to 40 inches.

Of minor extent in this unit are the very deep Granile soils and the moderately deep Amesmont soils on

mountain slopes and foothills. Of minor extent in this unit are the very deep, somewhat poorly drained Silas soils and the very deep, poorly drained Vensora soils in the valleys.

This unit is used mainly for recreation or for wildlife habitat. Areas of the Rogert soils are also used as rangeland. A few areas of the Lakehelen soils are used for timber production.

Production of vegetation suitable for livestock grazing on the Rogert soils is limited by droughtiness. Production on the Lakehelen soils is limited by the dense tree canopy cover. Steep slopes limit access by livestock.

Timber harvesting on the Lakehelen soils is limited by steep slopes. Slow regrowth of trees is a limiting factor in the production of merchantable timber.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, and Rock outcrop. Some areas of this unit are crucial winter habitat for elk, mule deer, and antelope.

WY161 Redrob-Grenoble.

Very deep, poorly drained or somewhat poorly drained, nearly level soils on flood plains and low stream terraces.

Slopes are 0 to 3 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 55 percent Redrob and similar soils and 25 percent Grenoble and similar soils. The remaining 20 percent consists of components of minor extent.

The Redrob and similar soils are on nearly level flood plains and low stream terraces. These soils are very deep and poorly drained. They formed in alluvium derived from various sources. The soils have a medium textured surface layer. The upper part of the underlying material is moderately fine textured. The lower part is very gravelly and coarse textured. Depth to the very gravelly layer is 23 to 38 inches. Depth to the seasonal high water table is 0 to 24 inches from March through August. Most areas of these soils are subject to a rare hazard of flooding. Some areas, however, are subject to frequent brief flooding from May through June.

The Grenoble and similar soils are on nearly level flood plains and low stream terraces. These soils are very deep and somewhat poorly drained. They formed in alluvium derived from various sources. The soils have a gravelly coarse textured surface layer, and a very gravelly coarse textured underlying material. Depth to the seasonal high water table is 24 to 42 inches from March through August.

These soils are subject to frequent brief flooding from May through June.

Of minor extent in this unit are the well drained Bosler soils on higher stream terraces and in areas of riverwash on flood plains adjacent to the stream channel.

This unit is used mainly as rangeland or for wildlife habitat. A few areas are used for hay and pasture.

Production of hay and pasture or of vegetation suitable for livestock grazing is limited by wetness and salinity of the soils. Flooding is a limitation in the areas that are frequently flooded. Droughtiness of the Grenoble soils is also a limitation.

Included in this unit are habitat for species such as the water shrew, muskrat, beaver, raccoon, mink, white-tailed jackrabbit, thirteen-lined ground squirrel, desert and Nuttall's cottontail rabbits, coyote, red fox, and other mammals; and for birds common to pastures, hayland, prairies, and wetland shrubs and trees, as well as those species associated with water areas. Some areas of this unit are crucial winter habitat for mule deer and antelope. Crucial habitat for the Wyoming toad, an endangered species, occurs in the Mortenson Lake area.

WY202 Cheadle-Nathale-Rock Outcrop.

Shallow or moderately deep, well drained, gently sloping to very steep soils and Rock outcrop on ridges, canyon sides, and mountain slopes.

Slopes are 5 to 60 percent. The average annual precipitation is 15 to 19 inches, the average annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is about 35 percent Cheadle and similar soils, 20 percent Nathale and similar soils, and 20 percent Rock outcrop. The remaining 25 percent consists of components of minor extent.

The Cheadle and similar soils are on gently sloping to steep ridges and canyon sides. These soils are shallow and well drained. They formed in colluvium and residuum derived from sandstone and limestone. The soils have a moderately coarse textured surface layer, a channery moderately coarse textured subsoil, and a very channery moderately coarse textured substratum. Hard bedrock is at a depth of 10 to 20 inches.

The Nathale and similar soils are on strongly sloping to very steep mountain slopes and canyon sides. These soils are moderately deep and well drained. They formed in colluvium and residuum derived from limestone and sandstone. The soils have a gravelly moderately coarse textured surface layer, a very cobbly medium textured upper part of the subsoil, and a very cobbly moderately coarse textured lower part. Hard bedrock is at a depth of 20 to 40 inches.

The Rock outcrop consists of exposures of limestone and sandstone.

Of minor extent in this unit are the moderately deep, clayey Kildor soils and the moderately deep, moderately fine textured Miracle soils.

This unit is used mainly as rangeland or for wildlife habitat. A few areas are used for undeveloped recreation.

Production of vegetation on the Cheadle and Nathale soils suitable for livestock grazing is limited by the droughtiness of the soils. Slope in many areas of this unit limits access by livestock.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, canyon sides, and Rock outcrop. Some areas of this unit are crucial winter habitat for elk, mule deer, and antelope.

WY253 Pilotpeak-Canwall-Rock Outcrop.

Very shallow to moderately deep, well drained, gently sloping to steep soils and Rock outcrop on cuesta dip slopes, structural benches, and canyon sides.

Slopes are 3 to 30 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 30 percent Pilotpeak and similar soils, 20 percent Canwall and similar soils, and 20 percent Rock outcrop. The remaining 30 percent consists of components of minor extent.

The Pilotpeak and similar soils are on gently sloping to moderately steep cuesta dip slopes and structural benches. These soils are very shallow or shallow and are well drained. They formed in colluvium and residuum derived from limestone. The soils have a cobbly medium textured or cobbly moderately coarse textured surface layer. The subsoil is very cobbly or extremely cobbly and moderately coarse textured or medium textured. Hard bedrock is at a depth of 7 to 20 inches.

The Canwall and similar soils are on gently sloping to steep cuesta dip slopes and canyon sides. These soils are moderately deep and well drained. They formed in colluvium and eolian deposits derived from limestone and sandstone overlying residuum derived from limestone. The soils have a moderately coarse textured surface layer, a medium textured or moderately coarse textured upper part of the subsoil, and a very cobbly medium textured or very cobbly moderately coarse textured lower part. Hard bedrock is at a depth of 20 to 40 inches.

The Rock outcrop consists of exposures of limestone and sandstone.

Of minor extent in this unit are the very deep Joemre soils on alluvial fans in the valleys and Telecan soils on valley bottoms.

This unit is used mainly as rangeland or for wildlife habitat. A few areas are used for undeveloped recreation.

Production of vegetation suitable for livestock grazing on the Pilotpeak and Canwall soils is limited by the droughtiness of the soils and the low annual precipitation.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, canyon sides, and Rock outcrop. Some areas of this unit are crucial winter habitat for elk and mule deer.

WY254 Borollic Camborthids-Pahlow-Alcova.

Very deep, well drained, nearly level to strongly sloping soils on alluvial fans and terraces.

Slopes are 0 to 10 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 30 percent Borollic Camborthids and similar soils, 25 percent Pahlow and similar soils, and 20 percent Alcova and similar soils. The remaining 25 percent consists of components of minor extent.

The Borollic Camborthids and similar soils are on nearly level to gently sloping alluvial fans and terraces with a mounded microrelief. These soils are very deep and well drained. They formed in alluvium derived from various sources and modified by cryoturbation. The soils have a very gravelly moderately coarse textured surface layer. The subsoil is gravelly or very gravelly and moderately coarse textured or medium textured.

The Pahlow and similar soils are on nearly level terraces with a mounded microrelief. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a gravelly moderately coarse textured surface layer, a very gravelly moderately coarse textured upper part of the subsoil, and a very gravelly or extremely gravelly coarse textured lower part.

The Alcova and similar soils are on nearly level to strongly sloping alluvial fans and terraces. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a moderately coarse textured surface layer and a moderately fine textured upper part of the subsoil. The lower part of the subsoil is very gravelly and moderately fine textured, medium textured, or moderately coarse textured.

Of minor extent in this unit are the somewhat poorly drained Folavar soils on stream terraces and the shallow

Blazon and moderately deep Delphill soils on hillslopes. Also of minor extent are the saline, nongravelly Tisworth soils and the nongravelly Forelle and Rock River soils.

This unit is used mainly as rangeland or for wildlife habitat. A few areas are used for hay and pasture.

This unit has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation. (See figure 2.)

If this unit is used for hay and pasture, the main limitation is the droughtiness of the soils. The complex slopes in the areas of the mounded microrelief require special irrigation methods to properly apply irrigation water.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, pastures, hayland, and prairies. Some areas of this unit are crucial winter habitat for antelope. A few sage grouse breeding areas occur in this unit.

WY255 Forelle-Poposhia-Diamondville.

Moderately deep or very deep, well drained, nearly level to moderately steep soils on terraces, fan aprons, hills, and ridges.

Slopes are 0 to 30 percent. The average annual precipitation is 10 to 14 inches, the average annual air

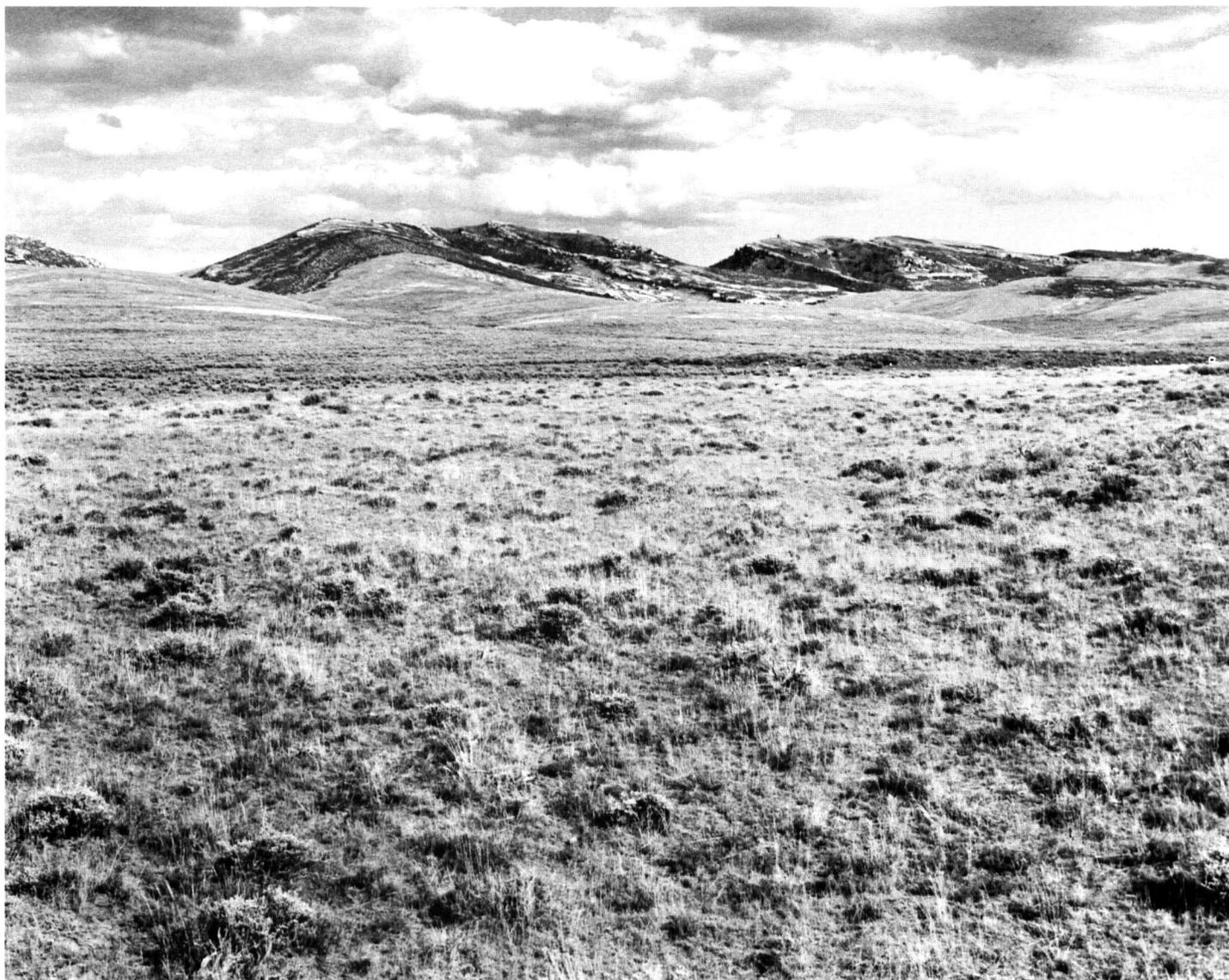


Figure 2.—Area near Wallrock Canyon. In the foreground is the Borollic Camborthids-Pahlow-Alcova general soil map unit. In the background is the general soil map unit of Pilotpeak-Canwall-Rock outcrop.

temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 30 percent Forelle and similar soils, 20 percent Poposhia and similar soils, and 15 percent Diamondville and similar soils. The remaining 35 percent consists of components of minor extent.

The Forelle and similar soils are on nearly level to gently sloping terraces, fan aprons, and hills. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a moderately coarse textured surface layer and a medium textured to moderately fine textured subsoil.

The Poposhia and similar soils are on gently sloping to moderately steep hills, ridges, and fan aprons. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a medium textured surface layer and subsoil.

The Diamondville and similar soils are on nearly level to strongly sloping ridges and hills. These soils are moderately deep and well drained. They formed in alluvium derived from sandstone and shale. The soils have a moderately coarse textured surface layer, a medium textured upper part of the subsoil, and a moderately coarse textured lower part. Weakly consolidated bedrock is at a depth of 20 to 40 inches.

Of minor extent in this unit are the shallow Blazon soils on hillslopes; as well as the Bosler and Alcova soils, which have a very gravelly substratum, on terraces and alluvial fans.

This unit is used mainly as rangeland or for wildlife habitat. It has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes and prairies. Some areas of this unit are crucial winter habitat for mule deer and antelope. A few sage grouse breeding areas occur in this unit.

WY256 Gerdrum Family-Tisworth-Elkol.

Very deep, well drained, nearly level to gently sloping soils on fan terraces, stream terraces, and hillslopes.

Slopes are 0 to 8 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period 85 to 110 days.

This unit is about 25 percent Gerdrum Family and similar soils, 25 percent Tisworth and similar soils, and 20 percent Elkol and similar soils. The remaining 30 percent consists of components of minor extent.

The Gerdrum Family and similar soils are on nearly level to gently sloping stream terraces, fan terraces, and hillslopes. These soils are very deep and well drained.

They formed in alluvium derived from various sources. The soils have a medium textured surface layer, a moderately fine textured upper part of the subsoil, and a fine textured lower part. The upper part of the subsoil is strongly alkaline. The lower part of the subsoil is moderately saline.

The Tisworth and similar soils are on nearly level to gently sloping stream terraces and fan terraces. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a moderately coarse to moderately fine textured surface layer and a moderately fine textured subsoil. The subsoil is strongly to very strongly alkaline and moderately saline.

The Elkol and similar soils are on nearly level to gently sloping stream terraces and hillslopes adjacent to playas. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a moderately fine textured surface layer and subsoil. These soils are strongly alkaline and slightly saline.

Of minor extent in this unit are the nonsaline, shallow Blazon and Moyerson soils and the nonsaline, moderately deep Chaperton and Delphill soils. Also of minor extent are the very deep, nonsaline Forelle and Bosler soils.

This unit is used mainly as rangeland or for wildlife habitat. Production of vegetation suitable for livestock grazing is limited by the salinity and alkalinity of the soils and by the low annual precipitation.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes and prairies. Some areas of this unit are crucial winter habitat for antelope. A few sage grouse breeding areas occur in this unit.

WY258 Wycolo-Tieside-Fiveoh.

Shallow, moderately deep, or very deep, well drained, nearly level to moderately steep soils on cuestras, hills, structural benches, alluvial fans, and terraces.

Slopes are 1 to 20 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 30 percent Wycolo and similar soils, 25 percent Tieside and similar soils, and 20 percent Fiveoh and similar soils. The remaining 25 percent consists of components of minor extent.

The Wycolo and similar soils are on nearly level to moderately steep cuestras, hills, structural benches, and terraces. These soils are moderately deep and well drained. They formed in residuum derived from interbedded sandstone and shale. The soils have a moderately coarse textured surface layer and a moderately fine textured to medium textured subsoil.

Weakly consolidated bedrock is at a depth of 20 to 40 inches. (See figure 3.)

The Tieside and similar soils are on gently sloping to strongly sloping cuesta dip slopes, hillslopes, structural benches, and strath terraces. These soils are shallow and well drained. They formed in residuum derived from interbedded sandstone, limestone, and shale. The soils have a moderately coarse textured surface layer and subsoil. Weakly consolidated bedrock is at a depth of 10 to 20 inches.

The Fiveoh and similar soils are on nearly level to gently sloping alluvial fans and terraces. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a moderately

coarse textured surface layer and subsoil. In some areas, the lower part of the subsoil is very cobbly.

Of minor extent in this unit are the very deep Almy and Joemre soils and the very deep, moderately well drained Alogia soils.

This unit is used mainly as rangeland or for wildlife habitat. Small areas near Laramie are used for homesites and other urban developments. (See cover photo.)

This unit has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the droughtiness of the Tieside soils and by the low annual precipitation.

If this unit is used for homesites and urban developments, the main limitations are the depth to



Figure 3.—An area of the Wycolo-Tieside-Fiveoh general soil map unit near Marshall road north of Rock Creek. The Wycolo and Tieside soils are on the hills and cuestas in the foreground. On the terrace in the upper right corner is the Fiveoh soil.

bedrock in the Tieside and Wycolo soils and the slope in areas where it is more than 8 percent.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes and prairies. Some areas of this unit are crucial winter habitat for mule deer and antelope. A few sage grouse breeding areas occur in this unit.

WY314 Bateson-Forelle.

Very deep, well drained, nearly level to strongly sloping soils on terraces, hills, fan aprons, and breaks of dissected pediments.

Slopes are 0 to 15 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 40 percent Bateson and similar soils and 40 percent Forelle and similar soils. The remaining 20 percent consists of components of minor extent.

The Bateson and similar soils are on strongly sloping breaks of dissected pediments. These soils are very deep and well drained. They formed in alluvium derived from various sources overlying residuum derived from tuffaceous conglomerate. The soils have a gravelly moderately fine textured surface layer and upper part of the subsoil and a very gravelly coarse textured lower part.

The Forelle and similar soils are on nearly level to gently sloping terraces, fan aprons, and hills. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a moderately coarse textured surface layer, a moderately fine textured upper part of the subsoil, and a medium textured lower part.

Of minor extent in this unit are the shallow Rentsac soils and the moderately deep Diamondville soils.

This unit is used mainly as rangeland or for wildlife habitat. It has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes and prairies. Some areas of this unit are crucial winter habitat for mule deer.

WY357 Miracle-Cheadle-Rock Outcrop.

Shallow to moderately deep, well drained, gently sloping to steep soils and Rock outcrop on mountain slopes, ridges, cuestas, and canyon sides.

Slopes are 5 to 45 percent. The average annual precipitation is 15 to 19 inches, the average annual air

temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is about 40 percent Miracle and similar soils, 30 percent Cheadle and similar soils, and 15 percent Rock outcrop. The remaining 15 percent consists of components of minor extent.

The Miracle and similar soils are on gently sloping to steep mountain slopes, ridges, cuestas, and canyon sides. These soils are moderately deep and well drained. They formed in alluvium, colluvium, and residuum derived from sandstone, limestone, and shale. The soils have a moderately coarse textured surface layer, a moderately fine textured upper part of the subsoil, and a moderately coarse textured lower part. Hard sandstone bedrock is at a depth of 20 to 40 inches.

The Cheadle and similar soils are on gently sloping to steep ridges, cuesta escarpments, and canyon sides. These soils are shallow and well drained. They formed in residuum and colluvium derived from sandstone and limestone. The soils have a moderately coarse textured surface layer, a channery moderately coarse textured subsoil, and a very channery moderately coarse textured substratum. Hard sandstone bedrock is at a depth of 10 to 20 inches.

Of minor extent in this unit are very deep moderately fine textured soils and moderately deep, very cobbly, moderately coarse textured soils.

This unit is used mainly as rangeland or for wildlife habitat. A few areas are used for undeveloped recreation.

Steepness of slope limits access by livestock to many areas of this unit. The Miracle soils are well suited to the production of vegetation suitable for livestock grazing. Production on the Cheadle soils is limited by the droughtiness of the soils.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, canyon sides, and Rock outcrop. Some areas of this unit are crucial winter habitat for mule deer.

WY374 Poposhia-Blazon-Ipson

Very shallow, shallow, or very deep and well drained soils on nearly level to steep alluvial fans, fan aprons, hills, fan terraces, escarpments, and ridges.

Slopes are 1 to 45 percent. The average annual precipitation is 10 to 17 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is less than 85 to 110 days.

This map unit is about 30 percent Poposhia and similar soils, 25 percent Blazon and similar soils, and 15 percent

Ipson and similar soils. The remaining 30 percent consists of soils of minor extent.

Poposhia soils are on nearly level to steep fan aprons and hills. These soils are very deep and well drained. They formed in alluvium. They are medium textured throughout the profile.

Blazon soils are on nearly level to steep ridges, fan terraces, escarpments, and hills. These soils are very shallow or shallow and are well drained. They formed in colluvium and residuum derived from loamstone. They are moderately fine textured throughout the profile. Depth to bedrock ranges from 8 to 20 inches.

Ipson soils are on gently sloping to steep alluvial fans and fan terraces. These soils are very deep and well drained. They formed in gravelly alluvium. They have a gravelly and moderately coarse textured surface layer. The upper part of the subsoil is very gravelly and moderately fine textured. The lower part is very gravelly and moderately coarse textured.

Of minor extent in this unit are the moderately deep medium textured Chaperton soils on hills; the very deep moderately fine textured Evanston soils on hills and alluvial fans; and Rock outcrop on hills, escarpments, and ridges.

This unit is used for rangeland and as wildlife habitat.

This unit is moderately suited for livestock grazing. Steepness of slope in many areas limits access by livestock. Production of vegetation suitable for livestock grazing on areas of the Blazon soil is limited by the droughtiness of the soil.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, canyon sides, and Rock outcrop. Some areas of this unit are crucial winter habitat for elk, mule deer, and antelope.

WY379 Browtine-Lymanson-Dahlquist.

Moderately deep or very deep, well drained, nearly level to moderately steep soils on hills and fan terraces.

Slopes are 0 to 45 percent. The average annual precipitation is 10 to 19 inches, the average annual air temperature is 38 to 45 degrees F, and the average frost-free period is less than 60 to 110 days.

This unit is about 30 percent Browtine and similar soils, 25 percent Lymanson and similar soils, and 20 percent Dahlquist and similar soils. The remaining 25 percent consists of components of minor extent.

The Browtine and similar soils are on nearly level to steep fan terraces and hillslopes. These soils are very deep and well drained. They formed in alluvium and outwash derived from various sources. The soils have a very gravelly moderately coarse textured surface layer

and subsoil. The substratum is extremely gravelly and moderately coarse textured.

The Lymanson and similar soils are on gently sloping to moderately steep hills and fan terraces. These soils are moderately deep and well drained. They formed in alluvium and residuum derived from sedimentary rocks. The soils have medium textured surface layer and a moderately fine textured subsoil. Weakly consolidated bedrock is at a depth of 20 to 40 inches.

The Dahlquist and similar soils are on nearly level to gently sloping fan terraces. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a very gravelly moderately coarse textured surface layer. The upper part of the subsoil is very gravelly or very cobbly and moderately fine textured. The lower part of the subsoil is very gravelly and moderately coarse textured.

Of minor extent in this unit are the very deep, moderately fine textured Leavitt and Rock River soils; the very deep, moderately coarse textured Rawlins soils; and the shallow Blackhall soils.

This unit is used mainly as rangeland or for wildlife habitat. This unit has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the droughtiness of the soils.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes and prairies. Some areas of this unit are crucial winter habitat for elk, mule deer, and antelope.

WY380 Cutback-Shirleybasin-Twocabin.

Moderately deep or very deep, well drained, nearly level to moderately steep soils on pediments, ridges, and breaks.

Slopes are 0 to 25 percent. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 35 percent Cutback and similar soils, 30 percent Shirleybasin and similar soils, and 15 percent Twocabin and similar soils. The remaining 20 percent consists of components of minor extent.

The Cutback and similar soils are on nearly level to moderately steep pediments. These soils are moderately deep and well drained. They formed in alluvium and residuum derived from conglomerate and tuff. The soils have a moderately coarse textured surface layer and a moderately fine textured upper part of the subsoil. The lower part of the subsoil is very gravelly and moderately coarse textured. Weakly consolidated bedrock is at a depth of 20 to 40 inches.

The Shirleybasin and similar soils are on nearly level to gently sloping pediment summits and foot slopes of

pediment breaks. These soils are very deep and well drained. They formed in alluvium and residuum derived from tuffaceous sedimentary rocks. The soils have a medium textured surface layer, a moderately fine textured and fine textured upper part of the subsoil, and a gravelly moderately fine textured lower part.

The Twocabin and similar soils are on gently sloping to strongly sloping crests of ridges, breaks, and knobs on dissected pediments. These soils are very deep and well drained. They formed in alluvium derived from various sources. The soils have a gravelly medium textured surface layer and a very gravelly medium to moderately

fine textured upper part of the subsoil. The lower part of the subsoil is medium textured.

Of minor extent in this unit are the shallow Tule and Chalkville soils.

This unit is used mainly as rangeland or for wildlife habitat. This unit has few limitations for use as rangeland. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the droughtiness of the Twocabin soil.

Included in this unit are habitat for species such as the desert cottontail rabbit, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes

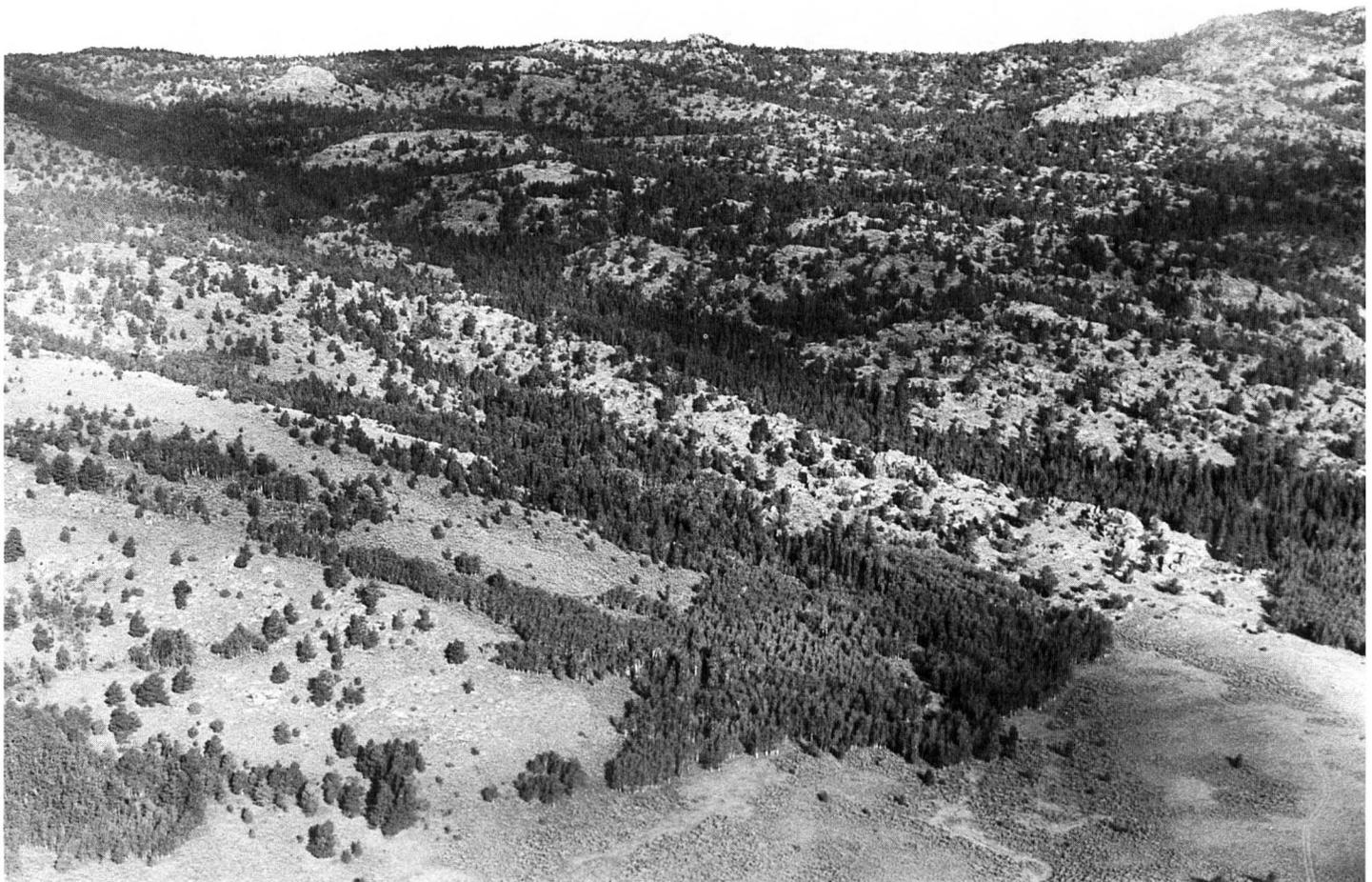


Figure 4.—An area of the Rock outcrop-Cathedral-Alderon general soil map unit in the Laramie Range near Toltec. The remaining 30 percent consists of components of minor extent.

and prairies. A few sage grouse breeding areas occur in this unit.

WY381 Rock Outcrop-Cathedral-Alderon.

Rock outcrop and shallow and moderately deep, well drained, gently sloping to very steep soils on foothills and mountains.

Slopes are 5 to 50 percent. The average annual precipitation is 15 to 19 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is about 30 percent Rock outcrop, 25 percent Cathedral and similar soils, and 15 percent Alderon and similar soils. (See figure 4.)

The Rock outcrop consists of exposures of granite.

The Cathedral and similar soils are on gently sloping to steep foothills and mountains. These soils are shallow and well drained. They formed in colluvium and residuum derived from granite. The soils have a very stony moderately coarse textured surface layer and a very gravelly moderately coarse textured underlying material. Hard bedrock is at a depth of 10 to 20 inches.

The Alderon and similar soils are on gently sloping to very steep foothills and mountain slopes. These soils are moderately deep and well drained. They formed in colluvium and residuum derived from granite. The soils

have a moderately coarse textured surface layer, a gravelly moderately fine textured subsoil, and a very gravelly moderately coarse textured substratum. Weakly consolidated bedrock is at a depth of 20 to 40 inches.

Of minor extent in this unit are the very deep, moderately well drained Dalecreek soils in the valleys and the very deep Granile soils in areas of lodgepole pine on the foothills and mountain slopes.

This unit is used mainly as rangeland or for wildlife habitat. A few areas are used for timber production or for undeveloped recreation.

Production of vegetation suitable for livestock grazing is limited by the amount of Rock outcrop in the unit, the droughtiness of the Cathedral soils, and the tree canopy cover on the Alderon soil. In many areas, slope limits access by livestock.

If the Alderson soils are used for timber production, the main limitations are slope and the slow regrowth of the trees.

Included in this unit are habitat for species such as the white-tailed jackrabbit, thirteen-lined ground squirrel, red squirrel, yellow-bellied marmot, desert cottontail, porcupine, coyote, red fox, badger, and other mammals; and for birds common to shrub steppes, coniferous forests, and Rock outcrop. Several areas in this unit are crucial winter habitat for elk, mule deer, and bighorn sheep.

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 about each map unit is given under the heading "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 behavioral characteristics 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 segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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, 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, in slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Rock River sandy loam is a phase of the Rock River series.

Most of the 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. Bonjea-Chugcreek-Rock outcrop, 3 to 15 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. Rainbolt-Morset association, 3 to 25 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 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

100—Aberone gravelly sandy loam, 0 to 15 percent slopes.

This very deep, well drained soil is on dissected fan terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 5,500 to 6,000 feet. The annual precipitation is 12 to 14 inches, the annual air temperature is 45 to 49 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Chaperton loam and Poposhia loam. Also included are areas of shallow soils on steeper slopes of dissected fan terraces. Included areas make up about 15 percent of the total acreage.

Typically 15 percent of the surface is covered with gravel. The surface layer is brown gravelly sandy loam 8 inches thick. The upper part of the subsoil is pinkish gray very gravelly sandy loam 7 inches thick. The lower part is very pale brown extremely gravelly coarse sandy loam to a depth of 60 inches or more.

Permeability of the Aberone soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate in the lower part of the subsoil restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

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

The potential plant community on the Aberone soil is mainly prairie sandreed, needleandthread, threadleaf sedge, blue grama, and sand bluestem. As the range condition deteriorates, threadleaf sedge and fringed sagewort increase. As the range condition further deteriorates, broom snakeweed, milkweed, and annual grasses invade. The potential plant community produces about 1,000 pounds of air-dry vegetation per acre in

normal years. Production ranges from 1,300 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the droughtiness of the soil.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately well suited for mechanical range renovation and for range seeding. The main limitations are the gravelly surface layer and the hazard of wind erosion. The low annual precipitation should be of concern when planning range seedings. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Shallow Sandy, 12- to 14-inch precipitation, Southern Plains range site.

101—Abston-Bullock complex, 5 to 25 percent slopes.

This map unit is on hillslopes and terrace escarpments. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,000 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Abston loam and 40 percent Bullock 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 Gerdrum Family loam, Blazon clay loam, Diamondville fine sandy loam, and Tisworth sandy loam. Included areas make up about 20 percent of the total acreage.

The Abston soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from shale. Typically the surface layer is dark yellowish brown loam 2 inches thick. The upper 3 inches of the subsoil are strongly alkaline, dark yellowish brown clay loam. The next 13 inches are very strongly alkaline, yellowish brown clay loam. The lower part is very strongly alkaline yellowish brown silty clay loam 7 inches thick. Weakly consolidated sodic shale is at a depth of 25 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Abston soil is very slow. Available water capacity is low. 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 Bullock soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from shale interbedded with sandstone. Typically the surface is 25 percent covered with gravel. The surface layer is brown sandy loam 2 inches thick. The upper part of the subsoil is strongly alkaline, yellowish brown clay loam 6 inches thick. The next 8 inches are very strongly alkaline, yellowish brown clay loam. The lower part is very strongly alkaline, light gray loam 8 inches thick. Weakly consolidated sandstone interbedded with shale is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Bullock soil is moderately slow. Available water capacity is low. 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 severe.

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

The potential plant community on the Abston soil is mainly birdfoot sagebrush, western wheatgrass, bottlebrush squirreltail, gardner saltbush, and Indian ricegrass. As the range condition deteriorates, birdfoot sagebrush increases. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

The potential plant community on the Bullock soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, gardner saltbush, birdfoot sagebrush, and big sagebrush. As the range condition deteriorates, bottlebrush squirreltail, blue grama, birdfoot sagebrush, and gardner saltbush increase. As the range condition further deteriorates, foxtail barley and annual grasses and weeds invade. The potential plant community produces about 700 pounds of air-dry vegetation per acre in normal years. Production ranges from 900 pounds in favorable years to 500 pounds in unfavorable years.

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

Production of vegetation suitable for livestock grazing is limited by the alkalinity of the soils. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion.

This unit is poorly suited for stockwater ponds, mechanical range renovation, or range seeding. The main

limitations for stockwater ponds are the slope and the depth to bedrock. The main limitations for range seeding or mechanical range renovation are the alkalinity of the soils, steepness of the slope, and the hazard of water erosion.

This unit is in capability subclass VIe, nonirrigated. The Abston soil is in the Impervious Clay, 10- to 14-inch High Plains Southeast range site; and the Bullock soil is in the Saline Loamy, 10- to 14-inch High Plains Southeast range site.

102—Alcova-Borollic Camborthids complex, 0 to 8 percent slopes.

This map unit is on alluvial fans and terraces with a mound-intermound pattern of micro-relief. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Alcova sandy loam and 35 percent Borollic Camborthids soil. The Alcova soil is on the toe slopes of the mounds and in the intermound areas. The Borollic Camborthids soil is on the mounds. 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 Bosler fine sandy loam, Forelle loam, Lupinto gravelly loam, and Tisworth fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Alcova soil is very deep and well drained. It formed in alluvium. (See figure 5.)

Typically the surface layer is pale brown sandy loam 3 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam 12 inches thick. The next 22 inches are very pale brown sandy clay loam. The lower part to a depth of 60 inches are pale brown very gravelly sandy clay loam.

Permeability of the Alcova 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 severe.

The Borollic Camborthids soil is very deep and well drained. It formed in alluvium derived from various sources modified by congeliturbation. These soils vary from area to area, and no single profile is typical. Commonly, the surface is 30 percent covered with fine gravel. The surface layer is commonly yellowish brown gravelly sandy loam or very gravelly sandy loam 3 inches thick. The upper part of the subsoil is commonly yellowish brown gravelly sandy loam or very gravelly sandy clay loam 7 inches thick. The lower part to a depth of 60

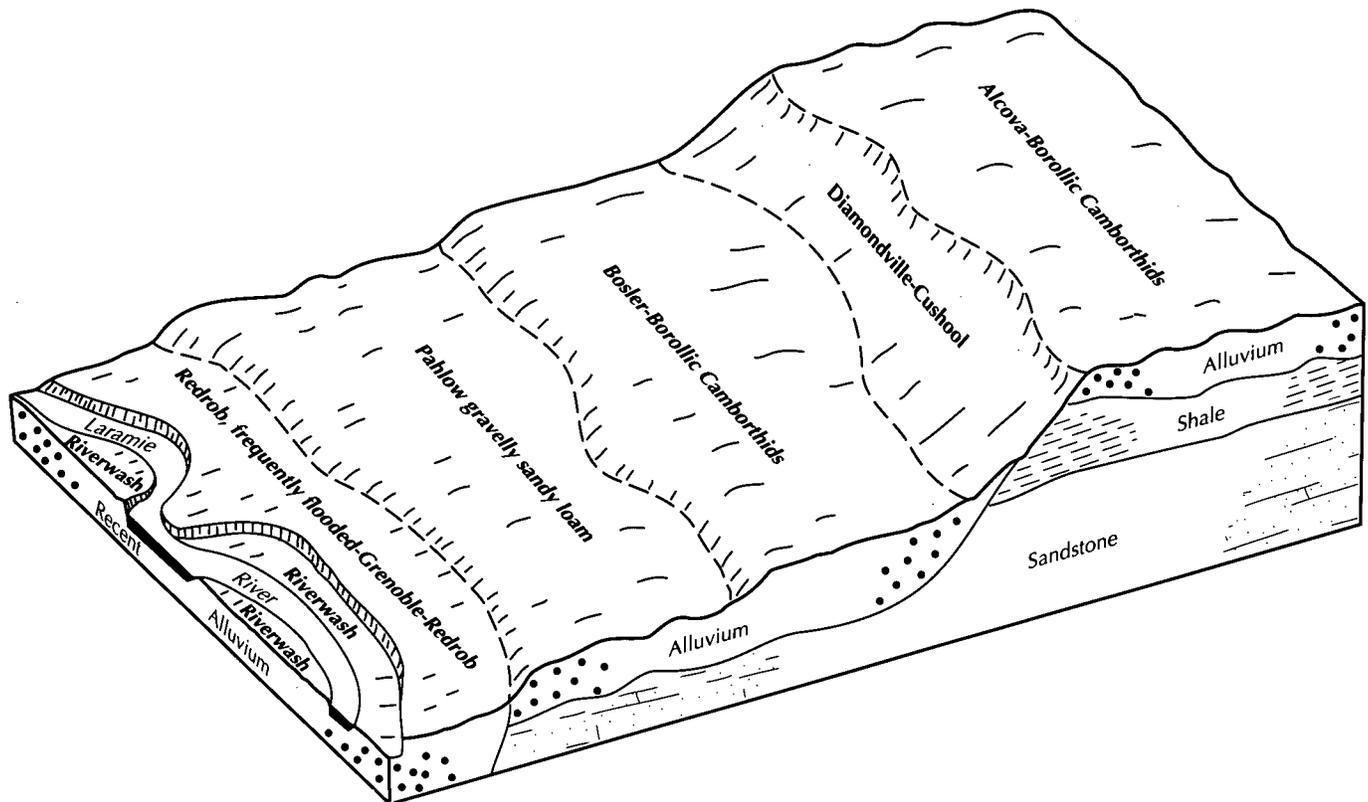


Figure 5.—A diagram of the relationship of some of the soils in the survey area to the parent materials in which they formed.

inches or more is commonly pale brown very gravelly sandy loam or very gravelly sandy clay loam.

Permeability of the Borloric Camborthids soil is moderate. 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 slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Alcova soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Borloric Camborthids soil is mainly needleandthread, Indian ricegrass, thickspike wheatgrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, silver sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500

pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is moderately well suited for stockwater ponds. The moderate potential for seepage losses is the main limitation. The Alcova soil is moderately well suited for mechanical range renovation and for range seeding; the main limitation is the hazard of wind erosion. The Borloric Camborthids soil is poorly suited for mechanical range renovation and range seeding; the main limitation is the very gravelly surface layer. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

The Alcova soil is in capability subclass IVe, nonirrigated. The Borloric Camborthids soil is in capability subclass VIc, nonirrigated.

The Alcova soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The

Borollic Camborthids soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

103—Alcova, shallow substratum-Lupinto-Dahlquist complex, 0 to 8 percent slopes.

This map unit is on fan terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Alcova loam, 20 percent Lupinto gravelly fine sandy loam, and 15 percent Dahlquist very gravelly 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 Browline very gravelly fine sandy loam, Rock River sandy loam, and Stunner sandy loam. Included areas make up about 15 percent of the total acreage.

The Alcova soil is very deep and well drained. It formed in alluvium. Typically the surface is 25 percent covered with gravel. The surface layer is brown loam 2 inches thick. The upper part of the subsoil is yellowish brown clay loam and sandy clay loam 14 inches thick. The next part is very pale brown very gravelly loam 11 inches thick. The lower part is light yellowish brown extremely gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Alcova soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

The Lupinto soil is very deep and well drained. It formed in alluvium. Typically the surface is covered with 10 percent gravel. The surface layer is brown gravelly fine sandy loam 2 inches thick. The upper part of the subsoil is dark yellowish brown sandy clay loam 5 inches thick. The next part is very pale brown very gravelly loam 17 inches thick. The lower part is very pale brown and light yellowish brown very gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Lupinto soil is moderate in the upper part of the subsoil and rapid in the lower part. 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 moderate.

The Dahlquist soil is very deep and well drained. It formed in alluvium. Typically the surface is covered with 50 percent gravel and cobbles. The surface layer is brown very gravelly loam 4 inches thick. The upper part of the

subsoil is strong brown and yellowish brown extremely gravelly sandy clay loam 16 inches thick. The lower part to a depth of 60 inches or more is yellowish brown extremely gravelly sandy loam.

Permeability of the Dahlquist soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is very 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 slight.

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

The potential plant community on the Alcova and Lupinto soils is mainly bluebunch wheatgrass, needleandthread, mutton bluegrass, black sagebrush, fringed sagewort, and western wheatgrass. As the range condition deteriorates, blue grama, Sandberg bluegrass, and forbs increase. As the range condition further deteriorates, cheatgrass and gumweed invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Dahlquist soil is mainly bluebunch wheatgrass, western wheatgrass, little bluestem, and black sagebrush. As the range condition deteriorates, western wheatgrass and shrubs increase. As the range condition further deteriorates, annual forbs and weeds invade. The potential plant community produces about 1,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

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

This unit is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately well suited for mechanical range renovation and for range seeding; the main limitation is the gravel in the surface layer of the Lupinto and Dahlquist soils. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. The low annual precipitation should also be of concern when planning range seedings.

The Alcova and Lupinto soils are in capability subclass IVe, nonirrigated. The Dahlquist soil is in capability

subclass VI_s, nonirrigated. The Alcova and Lupinto soils are in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site; the Dahlquist soil is in the Coarse Upland, 10- to 14-inch precipitation, High Plains Southeast range site.

104—Alcova, calcareous subsoil-Rock River complex, 0 to 8 percent slopes.

This map unit is on terraces and alluvial fan aprons with a mound-intermound pattern of microrelief. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 65 percent Alcova sandy loam and 20 percent Rock River very gravelly sandy loam. The Alcova soil occurs in intermound areas. The Rock River soil occurs on mounds. 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 Browline very gravelly fine sandy loam, Forelle fine sandy loam, and Tisworth sandy loam. Also included are small areas of Borollic Camborthids soils. Included areas make up about 15 percent of the total acreage.

The Alcova soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown sandy loam 2 inches thick. The upper part of the subsoil is dark yellowish brown clay loam 14 inches thick. The next 12 inches are very pale brown clay loam. The lower part to a depth of 60 inches or more is pale brown very gravelly sandy loam.

Permeability of the Alcova soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Rock River soil is very deep and well drained. It formed in alluvium. Typically the surface is covered with 50 percent gravel. The surface layer is brown very gravelly sandy loam 2 inches thick. The upper part of the subsoil is dark yellowish brown and light yellowish brown gravelly sandy clay loam 8 inches thick. The lower part to a depth of 60 inches or more is yellowish brown gravelly sandy clay loam.

Permeability of the Rock River 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 slight.

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

The potential plant community on the Alcova soil is mainly bluebunch wheatgrass, needleandthread, mutton bluegrass, black sagebrush, fringed sagewort, and western wheatgrass. As the range condition deteriorates, blue grama, Sandberg bluegrass, and forbs increase. As the range condition further deteriorates, cheatgrass and gumweed invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Rock River soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

The Alcova soil is poorly suited for stockwater ponds due to the potential for seepage losses. The Rock River soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation.

This unit is moderately well suited for mechanical range renovation and range seeding; the main limitations are the hazard of wind erosion on the Alcova soil and the very gravelly surface layer of the Rock River soil. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IV_e, nonirrigated. The Alcova soil is in the Shallow Loamy, 10- to 14-inch, High Plains Southeast range site; the Rock River soil is in the Loamy, 10- to 14-inch High Plains Southeast range site.

105—Almy loam, 0 to 8 percent slopes.

This very deep, well drained soil is on alluvial fan aprons. It formed in alluvium derived from reddish sandstone and shale. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Alogia loam, Forelle loam, Joemre fine sandy loam, Wycolo sandy loam, and a soil similar to the Almy soil but with a high amount of calcium carbonate in the lower subsoil. Included areas make up about 25 percent of the total acreage.

Typically the surface layer is reddish brown loam 2 inches thick. The upper part of the subsoil is reddish brown loam 9 inches thick. The next part is reddish yellow loam 11 inches thick. The next part is yellowish red sandy clay loam 13 inches thick. The lower part is yellowish red sandy loam to a depth of 60 inches or more.

Permeability of the Almy 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.

This unit is used mainly as rangeland and for wildlife habitat. A few areas are used for irrigated hay and pasture.

This unit is well suited for irrigated hay and pasture. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

The potential plant community on this unit is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is well suited for

mechanical range renovation and range seeding. The low annual precipitation should be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated and irrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

106—Almy-Urban land complex, 0 to 3 percent slopes.

This map unit is on terraces and foot slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This map unit is 65 percent Almy loam and 20 percent Urban land. 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 Alogia loam, Forelle loam, Joemre fine sandy loam, and Wycolo sandy loam. Included areas make up about 15 percent of the total acreage.

The Almy soil is very deep and well drained. It formed in alluvium derived from reddish sandstone and shale. Typically the surface layer is reddish brown loam 2 inches thick. The upper part of the subsoil is reddish yellow loam 14 inches thick. The next part is yellowish red sandy clay loam 13 inches thick. The lower part is yellowish red sandy loam to a depth of 60 inches or more.

Permeability of the Almy 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.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If the Almy soil is used for urban development, the main limitation is the shrink-swell potential and the moderately restricted permeability. Foundations of buildings and paved roads should be designed to offset the effects of the shrinking and swelling of the soils. If a septic system will be used, the absorption lines should be placed in the more permeable lower subsoil layers.

The Almy soil is in capability subclass IVc, nonirrigated.

107—Almy-Tismid association, 0 to 8 percent slopes.

This map unit is on dip slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,300 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 55 percent Almy fine sandy loam, 0 to 3 percent slopes, and 35 percent Tismid sandy clay loam, 3 to 8 percent slopes. The Almy soil is in concave areas; the Tismid soil is on convex slopes.

Included in this unit are small areas of a moderately deep soil similar to the Tismid soil. Also included are areas of a soil similar to the Almy soil, but with bedrock at a depth of 40 to 60 inches. Included areas make up about 10 percent of the total acreage.

The Almy soil is very deep and well drained. It formed in alluvium and residuum derived dominantly from reddish sandstone and shale. Typically the surface layer is light brown fine sandy loam 2 inches thick. The upper 12 inches of the subsoil are strong brown clay loam. The next part is reddish brown sandy clay loam 24 inches thick. The lower part is light reddish brown very fine sandy loam to a depth of 60 inches or more.

Permeability of the Almy 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 severe.

The Tismid soil is very deep and well drained. It formed in alluvium. Typically the surface layer is reddish brown sandy clay loam 2 inches thick. The upper 5 inches of the subsoil are light reddish brown sandy clay loam. The next part is light reddish brown strongly alkaline sandy clay loam 7 inches thick. The lower part is light reddish brown sandy clay loam to a depth of 60 inches or more.

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

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

The potential plant community on the Almy soil is mainly bluebunch wheatgrass, needleandthread, black sagebrush, and western wheatgrass. As the range condition deteriorates, blue grama, Sandberg bluegrass, and black sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Tismid soil is mainly western wheatgrass, bottlebrush squirreltail, gardner saltbush, birdfoot sagebrush, and Indian ricegrass. As the range condition deteriorates, sagebrush increases. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the alkalinity of the Tismid soil and by the low annual precipitation. Loss of the surface layer of the Tismid soil results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion.

The Almy soil is poorly suited for stockwater ponds due to the potential for seepage losses. The Tismid soil is well suited for stockwater ponds. The Almy soil is moderately well suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The Tismid soil is poorly suited for mechanical range renovation and range seeding; the main limitation is the alkalinity of the soil. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If range seedings are planned on the Tismid soil, seeding rates should be increased and plant species carefully selected because of the alkalinity of the soil. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

The Almy soil is in capability subclass IVc, nonirrigated. The Tismid soil is in capability subclass VI, nonirrigated. The Almy soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Tismid soil is in the Impervious Clay, 10- to 14-inch precipitation, High Plains Southeast range site.

108—Alogia loam, 0 to 3 percent slopes.

This very deep, moderately well drained soil is in seep areas and drainageways, and on alluvial fans and terraces adjacent to flood plains. This soil formed in alluvium

derived dominantly from reddish sandstone and shale. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Cattle loam in low areas adjacent to flood plains, and areas of Joemre fine sandy loam on higher terraces and alluvial fans. Also included are small areas of soils that are 20 to 40 inches deep to weakly consolidated shale or sandstone. Included areas make up about 15 percent of the total acreage.

Typically the surface layer is brown loam 3 inches thick. The upper part of the subsoil is brown loam 4 inches thick. The next 14 inches are light reddish brown clay loam. The lower part is pink loam 20 inches thick and contains many soft masses of gypsum. The substratum to a depth of 60 inches or more is reddish brown and reddish yellow clay loam and contains few to common soft masses of gypsum. The subsoil and substratum are slightly saline.

Permeability of the Alogia 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 water table fluctuates between 3 and 5 feet; the highest level is from April through July.

This unit is used as rangeland and for wildlife habitat. A few areas are used for irrigated hay and pasture.

The potential plant community on the Alogia soil is mainly alkali sacaton, basin wildrye, inland saltgrass, greasewood, and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

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

This soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. Pits dug sufficiently below the level of the water table can provide water for livestock during the period of the year when the water table is at its highest level. It is poorly suited for mechanical range renovation or for range seeding; the main limitation is the salinity of the soil. The low annual precipitation should also be of

concern when planning range seedings. If range seedings are conducted, seeding rates should be increased and plant species carefully selected because of the salinity of the soil.

If this unit is used for irrigated hay and pasture, the main limitation is the salinity of the soil. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil, the crop needs, and to the salt leaching requirement.

This unit is in capability subclass IVs, nonirrigated and irrigated. It is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site.

109—Alogia-Urban land complex, 0 to 3 percent slopes.

This map unit is in drainageways and on alluvial fans and terraces adjacent to flood plains. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This map unit is 70 percent Alogia loam and 15 percent Urban land. 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 Joemre fine sandy loam on higher terraces and alluvial fans. Also included are small areas of soils that are 20 to 40 inches deep to weakly consolidated shale or sandstone. Included areas make up about 15 percent of the total acreage.

The Alogia soil is very deep and moderately well drained. It formed in alluvium derived dominantly from reddish sandstone and shale. Typically the surface layer is brown loam 3 inches thick. The upper part of the subsoil is brown and light reddish brown clay loam 18 inches thick. The lower part is pink loam 20 inches thick. The substratum is reddish brown and reddish yellow clay loam to a depth of 60 inches or more. The subsoil and substratum are slightly saline.

Permeability of the Alogia 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 water table fluctuates between a depth of 3 and 5 feet; the highest level is from April through July.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If the Alogia soil is used for urban development, the main limitation is the high water table. Septic tank absorption fields buried in the soil do not function properly due to the high water table. In addition, if several septic systems are installed in an area, the water added to the soil may raise the level of the water table. Use of this soil as a site for buildings with basements is not recommended due to the high water table.

The Alogia soil is in capability subclass IVs, nonirrigated.

110—Anchutz sandy loam, 1 to 8 percent slopes.

This very deep, well drained soil is on fan terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Alcova sandy loam, Rawlins sandy loam, Rock River sandy loam, and Stunner sandy loam. Also included are small areas of Browline very cobbly sandy loam on terrace breaks. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is brown sandy loam 2 inches thick. The upper part of the subsoil is dark yellowish brown and yellowish brown sandy clay loam 13 inches thick. The next part is very pale brown clay loam and light yellowish brown sandy clay loam 24 inches thick. It contains a high amount of calcium carbonate. The lower part is light yellowish brown sandy loam to a depth of 60 inches or more.

Permeability of the Anchutz 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 severe.

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

The potential plant community on the Anchutz soil is mainly bluebunch wheatgrass, western wheatgrass, and black sagebrush. As the range condition deteriorates, shorter grasses, sedges, and black sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the high amount of calcium carbonate in the soil. Loss of the surface layer results in a decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing also should be managed to protect the unit from excessive erosion.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is well suited for mechanical range renovation and range seeding. The low annual precipitation should be of concern when planning range seedings.

This unit is in capability subclass IVe, nonirrigated. It is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

111—Ansel-Granile gravelly sandy loams, 6 to 45 percent slopes.

This map unit is on foothills and mountain alluvial fans. The native vegetation consists mainly of coniferous forest. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is 40 percent Ansel soil and 40 percent Granile soil. 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 Leavitt sandy loam and of Quander gravelly loam. Also included are small areas of a somewhat poorly drained soil that has a clayey substratum. Included areas make up about 20 percent of the total acreage.

The Ansel soil is very deep and well drained. It formed in alluvium derived from igneous and metamorphic rock. Typically the surface is covered with a 2-inch-thick layer of needle and bark residue. The surface layer is light brownish gray gravelly sandy loam 6 inches thick. The subsoil is light brown and light yellowish brown gravelly sandy clay loam 18 inches thick. The substratum is pale brown very gravelly sandy loam to a depth of 60 inches or more.

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

The Granile soil is very deep and well drained. It formed in alluvium derived from igneous and metamorphic rock. Typically the surface is covered with a 1-inch-thick layer of partially decomposed pine needles. The surface

layer is light brownish gray gravelly sandy loam 2 inches thick. The subsurface layer is light gray and pale brown very gravelly sandy loam 13 inches thick. The subsoil is light yellowish brown very gravelly sandy clay loam 9 inches thick. The substratum is pale brown very gravelly sandy loam to a depth of 60 inches or more.

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

This unit is used mainly for wildlife habitat, for recreation, and for post and pole production. A few areas are used for livestock grazing.

The present vegetation on this unit is lodgepole pine and understory consisting mainly of elk sedge, low sedge, creeping juniper, Oregongrape, kinnikinnick, Woods rose, heartleaf arnica, and aspen. Production of merchantable timber is about 40 to 50 cubic feet of lodgepole pine per acre per year. The site index for lodgepole pine is 50 to 60. The main limitations for timber production are steepness of the slope and the slow growth of the trees.

Production of vegetation suitable for livestock grazing is limited by the tree canopy cover, which limits the growth of the understory vegetation. If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is poorly suited for stockwater ponds due to the steepness of the slope.

This unit is in capability subclass VIIe, nonirrigated. It is lodgepole pine woodland.

112—Bateson-Shirleybasin association, 1 to 15 percent slopes.

This map unit is on dissected pediments adjacent to the Laramie Range. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,200 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Bateson gravelly sandy clay loam and 30 percent Shirleybasin loam. The Bateson soil is on knobs and pediment breaks with slopes of 8 to 15 percent. The Shirleybasin soil is on foot slopes of pediment breaks and on the broad summits of the pediments with slopes of 1 to 8 percent.

Included in this unit are small areas of Alcova sandy loam, Forelle loam, Rentsac sandy loam, and Rock River fine sandy loam. Also included are small areas of Rock

outcrop. Included areas make up about 30 percent of the total acreage.

The Bateson soil is very deep and well drained. It formed in alluvium derived from various sources overlying residuum derived from tuffaceous conglomerate. Typically the surface is 25 percent covered with gravel. The surface layer is brown gravelly sandy clay loam 2 inches thick. The upper part of the subsoil is brown and dark brown gravelly sandy clay loam 19 inches thick. The next part is red very gravelly sandy loam 8 inches thick. The lower part is pink very gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Bateson soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 20 to 40 inches because the coarse textures in the lower subsoil limit root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

The Shirleybasin soil is very deep and well drained. It formed in alluvium derived from tuffaceous sedimentary rocks. Typically the surface layer is brown loam 2 inches thick. The upper part of the subsoil is brown sandy clay loam 6 inches thick. The next part is brown clay loam 19 inches thick. The lower part is brown clay loam to a depth of 60 inches or more.

Permeability of the Shirleybasin 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 mainly as rangeland and for wildlife habitat. It is also used for recreation.

The potential plant community on the Bateson soil is mainly bluebunch wheatgrass, western wheatgrass, mutton bluegrass, needleandthread, and black sagebrush. As the range condition deteriorates, threadleaf sedge and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Shirleybasin soil is mainly western wheatgrass, needleandthread, bluebunch wheatgrass, and big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual grasses and forbs invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the droughtiness of the Bateson soil.

The Bateson soil is poorly suited for stockwater ponds due to the potential for seepage losses. The Shirleybasin soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Bateson soil is moderately well suited for mechanical range renovation and range seeding; the main limitation is the gravelly surface layer. The Shirleybasin soil is well suited for mechanical range renovation and range seeding. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. The Bateson soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Shirleybasin soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

113—Blackhall-Browtine, moist, complex, 15 to 45 percent slopes.

This map unit is on hillslopes of dissected fan terraces. The native vegetation consists mainly of forbs and grasses. Elevation is 7,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Blackhall very gravelly fine sandy loam and 30 percent Browtine very gravelly 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 Chaperton loam, Rawlins sandy loam, and Satanka fine sandy loam. Also included are small areas of soft and hard sandstone Rock outcrop. Included areas make about 20 percent of the total acreage.

The Blackhall soil is shallow and well drained. It formed in residuum derived from sandstone. Typically the surface is 30 percent covered with about 10 percent each gravel, cobbles, and stones. The surface layer is brown very gravelly fine sandy loam 2 inches thick. The subsoil is light

yellowish brown fine sandy loam 5 inches thick. The substratum is very pale brown fine sandy loam 11 inches thick. Weakly consolidated platy sandstone is at a depth of 18 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blackhall soil is moderately rapid. 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 slight.

The Browtine soil is very deep and well drained. It formed in alluvium. Typically the surface is 50 percent covered with gravel, cobbles, and a few stones. The surface layer is brown very gravelly sandy loam 3 inches thick. The subsoil is light yellowish brown very gravelly sandy loam and brownish yellow extremely gravelly sandy loam 16 inches thick. The upper part of the substratum is brownish yellow very gravelly coarse sandy loam and extremely cobbly coarse sandy loam 24 inches thick. The lower part is brownish yellow extremely gravelly sandy clay loam to a depth of 60 inches or more.

Permeability of the Browtine soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate and gravel limits root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

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

The potential plant community on the Blackhall soil is mainly bluebunch wheatgrass, Indian ricegrass, and needleandthread. As the range condition deteriorates, threadleaf sedge increases. As the range condition further deteriorates, annual grasses and forbs invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Browtine soil is mainly bluebunch wheatgrass, Idaho fescue, western wheatgrass, and threetip sagebrush. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,700 pounds in favorable years to 800 pounds in unfavorable years.

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

Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

This unit is in capability subclass VIIe, nonirrigated. The Blackhall soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. The Browline soil is in the Coarse Upland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

114—Blackhall-Satanka-Rock outcrop complex, 5 to 20 percent slopes.

This map unit is on ridges. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Blackhall sandy loam, 30 percent Satanka fine sandy loam, and 20 percent Rock outcrop. The Blackhall soil is interspersed with Rock outcrop along ridgetops. The Satanka soil is on shoulders of ridges. 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 Blazon loam and of Diamondville fine sandy loam. Included areas make up about 15 percent of the total acreage.

The Blackhall soil is shallow and well drained. It formed in residuum and colluvium derived from sandstone. Typically the surface is about 20 percent covered with channery fragments. The surface layer is pale brown sandy loam 2 inches thick. The subsoil is yellowish brown sandy loam 7 inches thick. The substratum is yellowish brown sandy loam 7 inches thick. Weakly consolidated sandstone is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blackhall soil is moderately rapid. 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 severe.

The Satanka soil is moderately deep and well drained. It formed in alluvium and residuum derived from sedimentary rocks. Typically the surface layer is pale brown fine sandy loam 4 inches thick. The upper part of the subsoil is brown sandy clay loam 5 inches thick. The

lower part is grayish brown and light gray sandy clay loam 26 inches thick. Weakly consolidated sandstone is at a depth of 35 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Satanka 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 severe.

Rock outcrop consists of exposures of sandstone and shale.

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

The potential plant community on the Blackhall soil is mainly bluebunch wheatgrass, Indian ricegrass, and needleandthread. As the range condition deteriorates, threadleaf sedge and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Satanka soil is mainly needleandthread, thickspike wheatgrass, Indian ricegrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, big sagebrush, rabbitbrush, and forbs increase. As the range condition further deteriorates, annuals and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

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

Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the droughtiness of the Blackhall soil. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. The low annual precipitation should also be of concern when planning range seedings.

Tillage of areas with a slope of more than 15 percent for range improvement is not recommended. Interseeding and seedbed preparation by band spraying of herbicides can be used in these areas. If tillage for range improvement is used on the less sloping areas, adequate

residue to reduce the hazards of wind and water erosion must be maintained on the surface at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope.

The Blackhall soil is in capability subclass VIIe, nonirrigated. The Satanka soil is in capability subclass VIe, nonirrigated. Rock outcrop is in capability class VIII.

The Blackhall soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. The Satanka soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near the Platte County line near Highway 34 are in similar range sites in the 12- to 14-inch precipitation, Southern Plains zone.

115—Blazon-Chaperton complex, moist, 3 to 20 percent slopes.

This map unit is on hills. The native vegetation consists mainly of grasses and forbs. Elevation is 6,500 to 6,800 feet. The annual precipitation is 15 to 17 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Blazon loam and 30 percent Chaperton 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 Blackhall sandy loam, Delphill clay loam, and Diamondville fine sandy loam. Also included are areas of shale and sandstone Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Blazon soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from shale, loamstone, and sandstone. Typically the surface layer is pale brown loam 5 inches thick. The underlying material is light brownish gray clay loam 10 inches thick. Weakly consolidated shale is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blazon 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 severe. The hazard of wind erosion is moderate.

The Chaperton soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from shale, loamstone, and sandstone. Typically the surface layer is light brownish gray clay loam 3 inches thick. The upper part of the subsoil is brownish gray clay loam 12 inches thick. The lower part is light brownish gray clay loam 9 inches thick. Weakly

consolidated shale is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Chaperton soil is moderate. Available water capacity is low. 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 mainly as rangeland and for wildlife habitat.

The potential plant community on the the Blazon soil is mainly western wheatgrass, green needlegrass, blue grama, winterfat, and bluebunch wheatgrass. As the range condition deteriorates, blue grama and buffalograss increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the the Chaperton soil is mainly western wheatgrass and green needlegrass. As the range condition deteriorates, blue grama and buffalograss increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,700 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. On the Blazon soil, production of vegetation suitable for livestock grazing is limited by droughtiness of the soil. The Chaperton soil is well suited to this production. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the hazard of water erosion. The low annual precipitation should also be of concern when planning range seedings.

Tillage of areas with a slope of more than 15 percent for range improvement is not recommended. Interseeding and seedbed preparation by band spraying of herbicides can be used in these areas. If tillage for range improvement is used on the less sloping areas, adequate residue to reduce the hazard of water erosion must be

maintained on the surface at all times until the seeding is established. Tillage should be along the contour of the slope.

The Blazon soil is in capability subclass VIIe, nonirrigated. The Chaperton soil is in capability subclass VIe, nonirrigated. The Blazon soil is in the Shallow Loamy, 15- to 17-inch precipitation, Southern Plains range site. The Chaperton soil is in the Clayey, 15- to 17-inch precipitation, Southern Plains range site.

116-Blazon-Delphill complex, 20 to 45 percent slopes.

This map unit is on escarpments. The native vegetation consists mainly of grasses. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Blazon loam and 25 percent Delphill 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 Blackhall sandy loam, Cushool sandy loam, and Diamondville fine sandy loam. Also included are areas of shale and sandstone Rock outcrop. Included areas make up about 30 percent of the total acreage.

The Blazon soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from interbedded shale and sandstone. Typically the surface layer is pale brown loam 5 inches thick. The underlying material is light brownish gray clay loam 10 inches thick. Weakly consolidated shale is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blazon 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 severe. The hazard of wind erosion is moderate.

The Delphill soil is moderately deep and well drained. It formed in residuum and local alluvium derived dominantly from interbedded shale and sandstone. Typically the surface layer is light brownish gray clay loam 3 inches thick. The underlying material is light brownish gray clay loam 25 inches thick. Weakly consolidated shale is at a depth of 28 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Delphill 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 as rangeland and for wildlife habitat.

The potential plant community on the the Blazon soil is mainly bluebunch wheatgrass, western wheatgrass, bottlebrush squirreltail, mutton bluegrass, and winterfat.

As the range condition deteriorates, shorter grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,000 pounds in favorable years to 500 pounds in unfavorable years.

The potential plant community on the the Delphill soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing.

Production of vegetation on the Blazon soil suitable for livestock grazing is limited by the droughtiness of the soil. The Delphill soil is well suited to this production. This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

This unit is in capability subclass VIIe, nonirrigated. The Blazon soil is in the Shallow Clayey, 10- to 14-inch precipitation, High Plains Southeast range site. The Delphill soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation, Southern Plains zone.

117—Bonjea-Chugcreek-Rock outcrop complex, 3 to 15 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Bonjea sandy loam, 30 percent Chugcreek 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 Boyle gravelly sandy loam and Lininger loam. Included areas make up about 15 percent of the total acreage.

The Bonjea soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite and gneiss. Typically the surface is brown sandy loam 4 inches thick. The upper 6 inches of the subsoil are brown sandy clay loam. The lower 5 inches are yellowish brown gravelly sandy clay loam. Hard granite is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches. In some areas, the surface layer is fine sandy loam.

Permeability of the Bonjea soil is moderate. 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 severe.

The Chugcreek soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss. Typically the surface is 10 percent covered with granitic gravel. The surface layer is brown sandy loam 4 inches thick. The upper 15 inches of the subsoil are dark yellowish brown sandy loam. The next 10 inches are dark yellowish brown sandy clay loam. The lower 9 inches are yellowish brown gravelly sandy clay loam. Hard granite is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Chugcreek 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 severe.

Rock outcrop consists of exposures of granite and gneiss.

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

The potential plant community on the Bonjea soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Chugcreek soil is mainly bluebunch wheatgrass, Griffith wheatgrass, prairie junegrass, big sagebrush, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation on the Bonjea soil suitable for livestock grazing is limited by the droughtiness of the soil. The Chugcreek is well suited to this production.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is also poorly suited for mechanical range renovation and range seeding. Tillage for range improvement is not recommended due to the areas of Rock outcrop which occur throughout the unit.

The Bonjea soil is in capability subclass VII_s, nonirrigated. The Chugcreek soil is in capability subclass IV_e, nonirrigated. Rock outcrop is in capability subclass VIII_s.

The Bonjea soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Chugcreek soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

118—Bonjea-Rock outcrop-Chugcreek complex, 15 to 40 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Bonjea sandy loam, 25 percent Rock outcrop, and 20 percent Chugcreek 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 Boyle gravelly sandy loam, Lininger loam, and a very shallow soil similar to the Bonjea soil. Included areas make up about 15 percent of the total acreage.

The Bonjea soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite and gneiss. The surface layer is brown sandy loam 4 inches thick. The upper 6 inches of the subsoil are brown sandy clay loam. The lower 5 inches of the subsoil are yellowish brown gravelly sandy clay loam. Hard granite is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Bonjea 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 severe. The hazard of wind erosion is severe.

Rock outcrop consists of exposures of granite and gneiss.

The Chugcreek soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss. Typically the surface layer is brown sandy loam about 5 inches thick. The upper part of the subsoil is dark brown sandy clay loam 12 inches thick. The lower part is brown sandy clay loam and clay loam 17 inches thick. The substratum is dark yellowish brown gravelly clay loam 2 inches thick. Hard granite is at a depth of 36 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Chugcreek 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 severe.

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

The potential plant community on the Bonjea soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Chugcreek soil is mainly bluebunch wheatgrass, Griffith wheatgrass, prairie junegrass, big sagebrush, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation on the Bonjea soil suitable for livestock grazing is limited by the droughtiness of the soil. The Chugcreek is well suited to the production. This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Bonjea and Chugcreek soils are in capability subclass VIIe, nonirrigated. Rock outcrop is in capability

subclass VIIIa. The Bonjea soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Chugcreek soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

119—Bosler fine sandy loam, wet substratum, 0 to 3 percent slopes.

This very deep, moderately well drained soil is on alluvial fans and terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Cattle loam and Redrob loam. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is grayish brown fine sandy loam 3 inches thick. The upper part of the subsoil is brown and yellowish brown sandy clay loam 17 inches thick. The lower part is yellowish brown very gravelly sand to a depth of 60 inches or more.

Permeability of the Bosler soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 18 to 36 inches because of the water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe. A seasonal high water table fluctuates between 1.5 and 3 feet from April through September. The water table is the result of irrigation of this soil and the adjacent soils.

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

If this unit is used for irrigated hay and pasture, the main limitations are wetness, droughtiness, and salinity of the soil. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Bosler soil is mainly alkali sacaton, basin wildrye, black greasewood,

and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

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

This soil is well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock. This soil is moderately well suited for mechanical range renovation and range seeding; the main limitations are the hazard of wind erosion and the salinity of the soil. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity of the soil.

This unit is in capability subclass IVw, nonirrigated and irrigated. It is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site.

120—Bosler-Borollic Camborthids complex, 0 to 8 percent slopes.

This map unit is on alluvial fans and terraces with a mound-intermound pattern of microrelief. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Bosler fine sandy loam and 35 percent Borollic Camborthids soil. The Bosler soil is on toe slopes of the mounds and in intermound areas. The Borollic Camborthids soil is on mounds. 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 Alcova sandy loam, Forelle loam, and Tisworth fine sandy loam. Also included are small areas of similar soils with redder colors. Included areas make up about 20 percent of the total acreage.

The Bosler soil is very deep and well drained. It formed in alluvium. Typically the surface layer is grayish brown fine sandy loam 7 inches thick. The upper part of the subsoil is brown sandy clay loam about 8 inches thick. The lower part is pale brown sandy clay loam and very pale brown loam 15 inches thick. The substratum is very pale brown very gravelly sand to a depth of 60 inches or more.

Permeability of the Bosler soil is moderate in the subsoil and rapid in the substratum. 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 Borollic Camborthids soil is very deep and well drained. It formed in alluvium. These soils vary from area to area, and no single profile is typical. Commonly, the surface is 30 percent covered with fine gravel. The surface layer is commonly pale brown gravelly sandy loam or very gravelly sandy loam about 3 inches thick. The upper part of the subsoil is commonly yellowish brown gravelly sandy clay loam or very gravelly sandy loam about 9 inches thick. The lower part to a depth of 60 inches or more is commonly light yellowish brown very gravelly sandy loam or very gravelly sandy clay loam.

Permeability of the Borollic Camborthids soil is moderately 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 slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Bosler soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Borollic Camborthids soil is mainly needleandthread, Indian ricegrass, thickspike wheatgrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, silver sagebrush, rabbitbrush, and cactus increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less

preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing in this unit is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the potential for seepage losses. This unit is moderately well suited for mechanical range renovation and range seeding; the main limitations are the gravelly surface layer of the Borollic Camborthids soil and the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of brush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

The Bosler soil is in capability subclass IVe, nonirrigated. The Borollic Camborthids soil is in capability subclass VIc, nonirrigated. The Bosler soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Borollic Camborthids soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

121—Bosler, wet substratum-Urban land complex, 0 to 3 percent slopes.

This map unit is on terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This map unit is 50 percent Bosler fine sandy loam and 30 percent Urban land. 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 Alcova sandy loam and Rock River sandy loam. Also included are small areas of Borollic Camborthids soils on mounds. Included areas make up about 20 percent of the total acreage.

The Bosler soil is very deep and well drained. It formed in alluvium. Typically the surface layer is grayish brown fine sandy loam 3 inches thick. The upper part of the subsoil is brown sandy clay loam 17 inches thick. The lower part is yellowish brown very gravelly sand to a depth of 60 inches or more.

Permeability of the Bosler soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches for some plants, but for others it is 18 to 36 inches because of the water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe. A seasonal high water table fluctuates between a depth of 1.5 and 3 feet from April through September.

The water table results from the irrigation of this soil and/or adjacent soils.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Reddish fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If the Bosler soil is used for urban development, the main limitation is the high water table. Septic tank absorption fields buried in the soil do not function properly due to the high water table. In addition, if several septic systems are installed in an area, the water added to the soil may raise the level of the water table. Use of this soil as a site for buildings with basements is not recommended due to the high water table.

The Bosler soil is in capability subclass IVw, nonirrigated.

122—Boyle-Alderon-Cathedral gravelly sandy loams, 5 to 25 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses, shrubs, and trees. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Boyle gravelly sandy loam, 30 percent Alderon gravelly sandy loam, and 15 percent Cathedral gravelly 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 Dalecreek sandy loam, Lininger loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Boyle soil is shallow and well drained. It formed in residuum derived dominantly from granite. Typically the surface is 70 percent covered with small granitic gravel. The surface layer is brown gravelly sandy loam 2 inches thick. The subsoil is brown very gravelly sandy clay loam 8 inches thick. Weakly consolidated granite is at a depth of 10 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Boyle soil is moderately rapid. 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. Winter winds remove the snow from the surface of this soil.

The Alderon soil is moderately deep and well drained. It formed in residuum and colluvium derived from granite. Typically the surface is covered with a mat of needles,

twigs, and bark 3 inches thick. The surface layer is brown gravelly sandy loam 6 inches thick. The subsoil is yellowish brown and strong brown gravelly sandy clay loam 28 inches thick. The substratum is yellowish brown very gravelly sandy loam 6 inches thick. Weakly consolidated granite is at a depth of 40 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Alderon 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 Cathedral soil is shallow and well drained. It formed in residuum and colluvium derived from granite. Typically the surface is covered with 50 percent granitic gravel and cobbles. The surface layer is brown gravelly sandy loam 7 inches thick. The underlying material is dark yellowish brown very gravelly coarse sandy loam. Hard granite is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Cathedral soil is rapid. 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 moderate. Winter winds remove the snow from the surface of this soil.

This unit is used mainly as rangeland and for wildlife habitat. A few small areas are used for recreation and for limited harvesting of wood products.

The potential plant community on the Boyle soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

The present vegetation on the Alderon soil is lodgepole pine with an understory of king spike fescue, elk sedge, low sedge, heartleaf arnica, Rocky Mountain maple, creeping juniper, currant, snowberry, antelope bitterbrush, mountain brome, bluebells, western yarrow, kinnikinnick, rose pussytoes, Richardson's geranium, bedstraw, and Woods rose.

The potential plant community on the Cathedral soil is mainly bluebunch wheatgrass, black sagebrush, threetip sagebrush, and slimstem muhly. As the range condition deteriorates, threadleaf sedge and low rabbitbrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 550 pounds of air-dry vegetation per acre in normal years. Production ranges

from 700 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Boyle and Cathedral soils and by the tree canopy cover on the Alderon soil.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the gravelly surface layer of the Boyle and Cathedral soils, the tree cover on the Alderon soil, and the hazard of water erosion.

The Alderon soil is moderately well suited to timber production. The site index for lodgepole pine ranges from 35 to 50. Production of merchantable timber is about 25 to 40 cubic feet of lodgepole pine per acre per year. The main limitation for timber production is the slow growth of the trees.

The Boyle and Cathedral soils are in capability subclass VIIe, nonirrigated. The Alderon soil is in capability subclass VIe, nonirrigated. The Boyle soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Cathedral soil is in the Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

123—Boyle-Boyle, thin solum, gravelly sandy loams, 3 to 6 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Boyle gravelly sandy loam and 40 percent Boyle gravelly sandy loam, 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 Cathedral gravelly coarse sandy loam, Dalecreek sandy loam, Linger loam, and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Boyle soil is shallow and well drained. It formed in residuum derived dominantly from granite. Typically the surface is 70 percent covered with fine granitic gravel. The

surface layer is brown gravelly sandy loam about 3 inches thick. The subsoil is reddish brown very gravelly sandy clay loam 10 inches thick. Weakly consolidated granite is at a depth of 13 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Boyle soil is moderately rapid. 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. Winter winds remove the snow from the surface of this soil.

The Boyle, thin solum soil is very shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 80 percent covered with fine granitic gravel. The surface layer is brown gravelly sandy loam 2 inches thick. The subsoil is brown very gravelly sandy clay loam 7 inches thick. Weakly consolidated granite at a depth of 9 inches. Depth to bedrock ranges from 7 to 10 inches. This soil is outside the characteristics of the Boyle series because the depth to bedrock is less than 10 inches. This difference, however, does not significantly affect the use and management of this soil.

Permeability of the Boyle, thin solum soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 7 to 10 inches. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight. Winter winds remove the snow from the surface of this soil.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Boyle soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Boyle, thin solum soil is mainly bluebunch wheatgrass, black sagebrush, threetip sagebrush, and slimstem muhly. As the range condition deteriorates, threadleaf sedge and low rabbitbrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 550 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance

of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the gravelly surface layer, depth to bedrock, and the droughtiness of the soils.

This unit is in capability subclass VII, nonirrigated. The Boyle soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Boyle, thin solum soil is in the Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

124—Boyle-Rock outcrop complex, 5 to 25 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Boyle gravelly sandy loam and 30 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 Cathedral gravelly coarse sandy loam and Lininger loam. Included areas make up about 20 percent of the total acreage.

The Boyle soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 45 percent covered with small granitic gravel. The surface layer is brown gravelly sandy loam 3 inches thick. The subsoil is brown very gravelly sandy clay loam 14 inches thick. Weakly consolidated granite is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Boyle soil is moderately rapid. 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. Winter winds remove the snow from the surface of this soil.

Rock outcrop consists of exposures of hard granite and highly weathered granite saprolite.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed,

and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the gravelly surface layer, depth to bedrock, and the droughtiness of the soils.

The Boyle soil is in capability subclass VIe, nonirrigated. Rock outcrop is in capability subclass VIII. The Boyle soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. Areas of this map unit near Iron Mountain are in a similar range site in the 15- to 17-inch precipitation Southern Plains zone.

125—Boyle-Lininger association, 1 to 15 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Boyle gravelly sandy loam, 1 to 15 percent slopes and 30 percent Lininger loam, 1 to 8 percent slopes. The Boyle soil is on the crests of foothills and on the upper parts of mountain slopes. The Lininger soil is on the foot slopes and lower parts of mountain slopes and foothills, and in swales on mountain slopes.

Included in this unit are small areas of Bonjea sandy loam, Cathedral gravelly coarse sandy loam, Chugcreek sandy loam, Dalecreek sandy loam, and Rock outcrop. Included areas make up about 25 percent of the total acreage.

The Boyle soil is shallow and well drained. It formed in residuum derived dominantly from granite. Typically the surface is 30 percent covered with small granitic gravel. The surface layer is brown gravelly sandy loam 3 inches thick. The upper 3 inches of the subsoil are brown gravelly sandy clay loam. The lower 6 inches are brown very gravelly sandy clay loam. Weakly consolidated granite is at a depth of 12 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Boyle soil is moderately rapid. 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. Winter winds remove the snow from the surface of this soil.

The Lininger soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from granite. Typically the surface is 30 percent covered with fine granitic gravel. The surface layer is brown loam 7 inches thick. The upper part of the subsoil is brown gravelly sandy clay loam 7 inches thick. The lower part is strong brown and brown very gravelly sandy clay loam 10 inches thick. Weakly consolidated granite is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Lininger soil is moderate. Available water capacity is very 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. Winter winds deposit additional snow on this soil.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is also poorly suited for mechanical range renovation and range seeding; the main limitations are the gravelly surface layer, the hazard of water erosion, and the droughtiness of the soils.

The Boyle soil is in capability subclass VII, nonirrigated, and the Lininger soil is in capability subclass VI, nonirrigated. This unit is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

126—Browline very gravelly fine sandy loam, 0 to 8 percent slopes.

This very deep, well drained soil is on fan terraces. It formed in alluvium. The native vegetation consists mainly

of grasses and shrubs. Elevation is 6,800 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Blackhall very gravelly fine sandy loam and of Dahlquist very gravelly sandy loam. Also included are small areas of Hanson gravelly sandy loam at higher elevations. Included areas make up about 20 percent of the total acreage.

Typically the surface is about 20 percent covered with fine gravel and a few cobbles. The upper 3 inches of the surface layer is brown very gravelly fine sandy loam. The lower 6 inches are pale brown very gravelly sandy loam. The upper part of the subsoil is white very gravelly sandy loam 5 inches thick. The lower part is white extremely gravelly loam about 17 inches thick. The substratum is brownish yellow extremely gravelly coarse sandy loam to a depth of 60 inches or more. The subsoil contains a high amount of calcium carbonate.

Permeability of the Browtine soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight.

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

The potential plant community on the Browtine soil is mainly bluebunch wheatgrass, Indian ricegrass, prairie junegrass, and needleandthread. As the range condition deteriorates, needleleaf sedge and rabbitbrush increase. As the range condition further deteriorates, annual grasses and forbs invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 650 pounds in favorable years to 300 pounds in unfavorable years.

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

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the very gravelly surface layer. Mechanical range renovation may not be economically feasible due to the coarse texture of the surface layer and the droughtiness of the soil. The low annual precipitation should also be of concern when planning range seedings.

This unit is in capability subclass VI_s, nonirrigated. It is in the Gravelly, 10- to 14-inch precipitation, High Plains Southeast range site.

127—Browtine-Hilltoppe very gravelly sandy loams, 0 to 8 percent slopes.

This map unit is on fan terraces. The native vegetation consists mainly of grasses. Elevation is 7,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 60 percent Browtine soil and 30 percent Hilltoppe soil. 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 Folavar very gravelly sandy loam and of Manada sandy loam. Included areas make up about 10 percent of the total acreage.

The Browtine soil is very deep and well drained. It formed in alluvium. Typically the surface is 10 percent covered, with about 5 percent gravel and 5 percent cobbles. The surface layer is brown very gravelly sandy loam 5 inches thick. The upper part of the subsoil is pale brown extremely gravelly sandy loam 7 inches thick. The next part is light gray extremely gravelly loam 10 inches thick. The next 20 inches are very pale brown extremely gravelly sandy loam. The substratum is pale brown extremely gravelly sandy loam to a depth of 60 inches or more. The subsoil contains a high amount of calcium carbonate.

Permeability of the Browtine soil is moderately rapid. Available water capacity is very low. Effective rooting depth for some plants is 60 inches or more, but for others it is only 15 to 30 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight.

The Hilltoppe soil is shallow and well drained. It formed in alluvium. Typically the surface is about 30 percent covered with gravel. The surface layer is brown very gravelly sandy loam 3 inches thick. The upper part of the subsoil is pale brown very gravelly sandy loam and very pale brown extremely gravelly sandy loam 11 inches thick. The next 19 inches are a layer of calcium carbonate-cemented gravel and fine cobbles. The substratum is pale brown extremely gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Hilltoppe soil is moderately rapid above the cemented layer. Available water capacity is very low. Effective rooting depth is 10 to 20 inches because the cemented layer restricts root growth. Runoff is slow and

the hazard of water erosion is moderate. The hazard of wind erosion is slight.

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

If this unit is used for hay and pasture, the main limitations are droughtiness of the soils and the restricted rooting depth of the Hilltoppe soil. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Frequent applications of irrigation water will be necessary because of the limited available water capacity of the soil. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Browtine soil is mainly bluebunch wheatgrass, Indian ricegrass, prairie junegrass, and needleandthread. As the range condition deteriorates, needleleaf sedge and rabbitbrush increase. As the range condition further deteriorates, annual grasses and forbs invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 650 pounds in favorable years to 300 pounds in unfavorable years.

The potential plant community on the Hilltoppe soil is mainly bluebunch wheatgrass, western wheatgrass, and bottlebrush squirreltail. As the range condition deteriorates, black sagebrush and threadleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 250 pounds in unfavorable years.

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

This unit is poorly suited for stockwater ponds due to the potential for seepage losses. The cemented layer in the Hilltoppe soil also limits the development of stockwater ponds. The unit also is poorly suited for mechanical range renovation and range seeding; the main limitation is the very gravelly surface layer. Mechanical range renovation may not be economically feasible due to the coarse texture of the surface layer and the droughtiness of the soil. The low annual precipitation should also be of concern when planning range seedings.

The Browtine soil is in capability subclass VI_s, nonirrigated and irrigated. The Hilltoppe soil is in capability subclass VII_s, nonirrigated and irrigated. The Browtine soil is in the Gravelly, 10- to 14-inch precipitation, High Plains Southeast range site. The Hilltoppe soil is in the Very Shallow, 10- to 14-inch precipitation, High Plains Southeast range site.

128—Bruja-Canwall-Telecan association, 3 to 60 percent slopes.

This map unit is on canyon sides and in valleys. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 30 percent Bruja very cobbly very fine sandy loam, 20 to 60 percent slopes; 25 percent Canwall gravelly fine sandy loam, 10 to 30 percent slopes; and 15 percent Telecan fine sandy loam, 3 to 6 percent slopes. Bruja is on north- and south-facing canyon sides. Canwall is on north-facing canyon sides. Telecan is in the valley bottoms.

Included in this unit is limestone or sandstone Rock outcrop occurring predominantly as resistant ledges. Also included are areas of Pilotpeak cobbly very fine sandy loam and a soil similar to the Telecan soil, but with bedrock at a depth of 30 to 60 inches. Included areas make up about 30 percent of the total acreage.

The Bruja soil is moderately deep and well drained. It formed in residuum and colluvium derived from interbedded sandstone and limestone. Typically the surface layer is 90 percent covered with gravel and cobbles. The surface layer is yellowish brown very cobbly very fine sandy loam 5 inches thick. The subsoil is light yellowish brown very cobbly very fine sandy loam and pale brown extremely cobbly very fine sandy loam 18 inches thick. Fractured interbedded sandstone and limestone is at a depth of 23 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Bruja soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 20 to 40 inches for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Canwall soil is moderately deep and well drained. It formed in eolian deposits, colluvium derived from limestone, and sandstone overlying residuum derived from limestone. Typically the surface is 25 percent covered with cobbles. The surface layer is dark yellowish

brown gravelly fine sandy loam 3 inches thick. The upper 9 inches of the subsoil are brown gravelly fine sandy loam. The next 5 inches are brown very cobbly fine sandy loam. The lower part is pink very cobbly fine sandy loam 9 inches thick. Hard limestone is at a depth of 26 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Canwall soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 20 to 40 inches for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

The Telecan soil is very deep and well drained. It formed in alluvium derived dominantly from interbedded sandstone and limestone. Typically the surface layer is brown fine sandy loam 4 inches thick. The upper 12 inches of the subsoil are dark brown fine sandy loam. The next 11 inches are dark yellowish brown fine sandy loam. The lower part is dark brown very fine sandy loam and brown fine sandy loam to a depth of 60 inches or more.

Permeability of the Telecan soil is moderately rapid. 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 severe.

This unit is used as rangeland, for wildlife habitat, and for recreation.

The potential plant community on the Bruja soil is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, and mountainmahogany. As the range condition deteriorates, threadleaf sedge, rabbitbrush, and shorter grass species increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 600 pounds of air-dry vegetation per acre in normal years. Production ranges from 800 pounds in favorable years to 350 pounds in unfavorable years.

The potential plant community on the Canwall soil is mainly bluebunch wheatgrass, Indian ricegrass, and needleandthread. As the range condition deteriorates, shorter species of grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Telecan soil is mainly needleandthread, thickspike wheatgrass, Indian ricegrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production

ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation on the Bruja and Canwall soils suitable for livestock grazing is limited by the droughtiness of the soils. The Telecan is well suited to this production.

The Bruja and Canwall soils are poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope. The Telecan soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately well suited for range seeding. The main limitation is the hazard of wind erosion. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Mechanical range renovation on the Telecan soil may not be practical due to the amount of sagebrush in the plant community. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

The Bruja soil is in capability subclass VIIe, nonirrigated. The Canwall soil is in capability subclass VIe, nonirrigated. The Telecan soil is in capability subclass IVe, nonirrigated. The Bruja soil is in the Rocky Hills, 10- to 14-inch precipitation, High Plains Southeast range site. The Canwall soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. The Telecan soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in the 15- to 17-inch precipitation Southern Plains zone.

129—Buffork-Bucklon sandy loams, 15 to 60 percent slopes.

This map unit is on foothills, ridges, and escarpments. The native vegetation consists mainly of grasses, forbs, and shrubs. Elevation is 7,600 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 40 percent Buffork sandy loam and 30 percent Bucklon 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 Leavitt sandy loam and Quander gravelly loam. Also included are small

areas of sandstone and conglomerate Rock outcrop. Included areas make up about 30 percent of the total acreage.

The Buffork soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from sedimentary rock. Typically the surface is 10 percent covered with 5 percent gravel and 5 percent cobbles. The surface layer is dark grayish brown and brown sandy loam 7 inches thick. The subsoil is brown sandy clay loam 10 inches thick. The substratum is light yellowish brown coarse sandy loam 9 inches thick. Weakly consolidated, coarse-grained sandstone is at a depth of 26 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Buffork soil is moderate. Available water capacity is very low. 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 severe.

The Bucklon soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from sedimentary rock. Typically the surface is 10 percent covered with gravel and a few cobbles. The surface layer is brown sandy loam 6 inches thick. The underlying material is light brownish gray and light yellowish brown loam 10 inches thick. Weakly consolidated sandstone is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Bucklon 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 severe. The hazard of wind erosion is severe. Slumping of this soil is common.

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

The potential plant community on the Buffork soil is mainly bluebunch wheatgrass, Griffith wheatgrass, prairie junegrass, and Idaho fescue. As the range condition deteriorates, Sandberg bluegrass, blue grama, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Bucklon soil is mainly bluebunch wheatgrass, Griffith wheatgrass, and sagebrush. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. The Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing also should be managed to protect the unit from excessive erosion.

The Buffork soil is well suited to the production of vegetation suitable for livestock grazing. Production on the Bucklon soil is limited by droughtiness of the soil. This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The unit is in capability subclass VIIe, nonirrigated. The Buffork soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Bucklon soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

130—Byrnie-Rock outcrop complex, 10 to 50 percent slopes.

This map unit is on escarpments and hillslopes. Blowout areas are a common landscape feature. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Byrnie sandy loam and 30 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 Joemre fine sandy loam, Rohonda fine sandy loam, Thermopolis fine sandy loam, and Wycolo sandy loam. Also included are small areas of a reddish sandy soil that has bedrock at a depth of 20 to 40 inches. Included areas make up about 20 percent of the total acreage.

The Byrnie soil is shallow and well drained. It formed in colluvium and residuum derived from interbedded limestone, sandstone, and shale. Typically the surface is 50 percent covered with gravel and cobbles. The surface layer is strong brown sandy loam 2 inches thick. The subsoil is strong brown and light brown gravelly sandy loam 10 inches thick. Weakly consolidated, interbedded sandstone, limestone, and shale is at a depth of 12 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Byrnie soil is moderately rapid. 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 severe.

Rock outcrop consists of exposures of limestone, reddish sandstone, and shale.

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

The potential plant community on the Byrnie soil is mainly bluebunch wheatgrass, needleandthread, western wheatgrass, and true mountainmahogany. As the range condition deteriorates, threadleaf sedge and rabbitbrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 600 pounds of air-dry vegetation per acre in normal years. Production ranges from 800 pounds in favorable years to 350 pounds in unfavorable years. Areas of this soil near Iron Mountain have slightly higher production.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing.

Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Byrnie soil, the low annual precipitation, and by the amount of Rock outcrop in the unit. This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Byrnie soil is in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. This unit is in the Rocky Hills, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone.

131—Calciborolls, 0 to 3 percent slopes.

This map unit is on stream terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is less than 85 to 110 days.

Included in this unit are small areas of Center Creek loam and Folavar very gravelly sandy loam. Also included are areas of similar soils with thinner surface layers. Included areas make up about 15 percent of the total acreage.

The Calciborolls soils are very deep and moderately well drained. They formed in alluvium. These soils are highly variable within short distances, and no single profile is typical. Commonly, the surface layer is brown loam or sandy loam 10 to 20 inches thick. The upper part of the subsoil is commonly very pale brown loam or clay loam 5 to 10 inches thick. The lower part is commonly white gravelly loam, gravelly clay loam, very gravelly loam, or very gravelly clay loam 15 to 30 inches thick. The substratum is commonly light yellowish brown very gravelly loam, very gravelly sandy loam, or very gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Calciborolls soil is moderate to moderately rapid. Available water capacity is low or moderate. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but for others it is 36 to 60 inches. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table is at a depth of 3 to 5 feet from April through August.

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

If this unit is used for irrigated hay and pasture, the main limitation is the alkalinity and the droughtiness of the soil. To avoid overirrigating, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. overirrigating creates a more shallow water table and leaches plant nutrients. Frequent applications of irrigation water will be necessary because of the limited available water capacity of the soil. Fertilizer is needed for optimum growth of plants and should be applied according to soil tests.

The potential plant community on this unit is mainly alkali sacaton, basin wildrye, and alkali bluegrass. As the range condition deteriorates, inland saltgrass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while 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. Production of vegetation suitable for livestock grazing is limited by the wetness and alkalinity of the soil.

Some areas of this unit are moderately well suited for stockwater ponds. With proper site selection, pits dug sufficiently below the level of the water table can provide water for livestock during the period of the year when the

water table is at its highest level. In some areas, the pits or other types of ponds will not hold water above the level of the water table for a long period of time due to the seepage potential in the substratum of the soil. Because some areas of this unit are poorly suited for stockwater ponds, an onsite investigation should be conducted to determine the suitability of a site. This soil is poorly suited for mechanical range renovation and range seeding; the main limitation is the alkalinity of the soil. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the alkalinity of the soil.

This unit is in capability subclass IVe, nonirrigated and irrigated. It is in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site.

132—Canburn loam, 1 to 4 percent slopes.

This very deep, poorly drained soil is on flood plains and stream terraces. It formed in alluvium. The native vegetation consists mainly of grasses. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Cattle loam in the Tie Siding and Red Butte areas, Dalecreek very fine sandy loam in areas of granite geological formations, and Wycolo sandy loam along the edges of the unit. Also included are very poorly drained soils in drainageways. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is brown loam 23 inches thick. The next layer is brown loam 27 inches thick. The underlying material to a depth of 60 inches or more is light brown coarse sandy loam.

Permeability of the Canburn soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for water-tolerant plants; but it is only 6 to 24 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table is at a depth of 6 to 24 inches from April through July. This soil is subject to frequent brief periods of flooding from April through June.

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

If this unit is used for hay and pasture, the main limitation is wetness. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied

only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Canburn soil is mainly basin wildrye, tufted hairgrass, and western wheatgrass. As the range condition deteriorates, sedges, rubber rabbitbrush, and willows increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 3,700 pounds of air-dry vegetation per acre in normal years. Production ranges from 4,300 pounds in favorable years to 3,000 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Production of vegetation suitable for livestock grazing is limited by the wetness of the soil.

This soil is well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock. This soil is moderately suited for mechanical range renovation and range seeding; the main limitation is wetness. Use of mechanical equipment on this soil is limited to the time of the year when the water table is the deepest. If range seedings are planned, plant species should be carefully selected because of the wetness of the soil.

This unit is in capability subclass Vw, nonirrigated and irrigated. It is in the Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this soil near Iron Mountain are in a similar range site in the 15- to 17-inch precipitation Southern Plains zone.

133—Cattle loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained soil is on flood plains and stream terraces. It formed in alluvium. The native vegetation consists mainly of grasses and grass-like plants. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Alogia loam on higher areas, Canburn loam, and Gerrard loam. Also included are small areas of Grenoble very gravelly sandy

loam in low-lying drainageways and Gypla silt loam near springs. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is brown loam about 5 inches thick. The next layer is brown loam 22 inches thick. The underlying material is brown and reddish brown silty clay loam to a depth of 60 inches or more. All layers of this soil are slightly saline.

Permeability of the Cantle soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 6 to 24 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight. A seasonal high water table fluctuates between 0.5 and 2 feet from May through July. This soil is subject to frequent brief periods of flooding from April through July.

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

If this unit is used for hay and pasture, the main limitations are the wetness and the salinity of the soil. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Cantle soil is mainly alkali sacaton, basin wildrye, and alkali bluegrass. As the range condition deteriorates, inland saltgrass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Production of vegetation suitable for livestock grazing is limited by the wetness and salinity of the soil.

This soil is well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock. This soil is moderately suited for mechanical range renovation and range seeding; the main limitations are wetness and salinity. Use of mechanical equipment on this soil is limited to the time of the year when the water table is the deepest. Mechanical range renovation may not be economically feasible due to the salinity of the soil. If range seedings are planned, plant species should be carefully selected because of the salinity and the wetness of the soil.

This unit is in capability subclass VI_s, nonirrigated and irrigated. This unit is in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this soil near Iron Mountain are in a similar range site in the 15- to 17-inch precipitation Southern Plains zone.

134—Carbol-Rock outcrop complex, 25 to 50 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 45 percent Carbol sandy loam and 45 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 Amesmont fine sandy loam, Hapjack gravelly sandy loam, Kezar fine sandy loam, Rogert gravelly sandy loam, and a very shallow soil similar to the Carbol soil. Included areas make up about 10 percent of the total acreage.

The Carbol soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface layer is brown sandy loam 3 inches thick. The subsoil is brown sandy clay loam 7 inches thick. The substratum is yellowish brown very cobbly sandy clay loam 4 inches thick. Hard granite is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Carbol 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 severe. The hazard of wind erosion is severe. Winter winds remove the snow from the surface of this soil.

Rock outcrop consists of exposures of anorthositic granite.

This unit is used as rangeland, for wildlife habitat, and for recreation.

The potential plant community on this unit is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf

sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. The Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soil. Due to the steepness of the slope, this unit is poorly suited for stockwater ponds, mechanical range renovation, or range seeding.

The Carbol soil is in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Carbol soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

135—Carmody-Edlin fine sandy loams, 15 to 45 percent slopes.

This map unit is on ridges and escarpments. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,500 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is 50 percent Carmody soil and 30 percent Edlin soil. The Carmody soil occurs on the shoulders of ridges and on escarpments. The Edlin soil occurs on back slopes and foot slopes of ridges and escarpments. 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 Blackhall sandy loam, Rock River sandy loam, Ryan Park fine sandy loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Carmody soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from sandstone. Typically the surface is 20 percent covered with gravel and cobbles. The surface layer is yellowish brown fine sandy loam 1 inch thick. The upper part of the underlying material is yellowish brown and light yellowish brown very fine sandy loam 11 inches thick. The lower part is very pale brown fine sandy loam 12 inches

thick. Weakly consolidated sandstone is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Carmody soil is moderately rapid. Available water capacity is very low. 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 severe.

The Edlin soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone. Typically the surface layer is brown fine sandy loam 3 inches thick. The upper part of the subsoil is brown and light yellowish brown fine sandy loam 20 inches thick. The lower part to a depth of 60 inches or more is pale yellow fine sandy loam and light yellowish brown sandy loam.

Permeability of the Edlin soil is moderately rapid. 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 severe.

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

The potential plant community on this unit is mainly bluebunch wheatgrass, Indian ricegrass, mutton bluegrass, and needleandthread. As the range condition deteriorates, shorter species of grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation. Due to the steepness of the slope, this unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding.

This unit is in capability subclass VIIe, nonirrigated. It is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

136—Carmody-Ryan Park fine sandy loams, 6 to 15 percent slopes.

This map unit is on hills and ridges. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,500 to 7,800 feet. The annual precipitation

is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is 40 percent Carmody soil and 40 percent Ryan Park soil. The Carmody soil occurs on the shoulders of the hills and ridges. The Ryan Park soil occurs on back slopes and toe slopes of the hills and ridges. 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 Blackhall sandy loam, Edlin fine sandy loam, Rock River sandy loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Carmody soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from sandstone. Typically the surface layer is dark yellowish brown and brown fine sandy loam 5 inches thick. The underlying material is pale brown fine sandy loam 24 inches thick. Weakly consolidated sandstone is at a depth of 29 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Carmody 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 severe.

The Ryan Park soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone. Typically the surface layer is brown fine sandy loam 1 inch thick. The upper part of the subsoil is dark yellowish brown and yellowish brown fine sandy loam 22 inches thick. The lower part is pale brown fine sandy loam to a depth of 60 inches or more.

Permeability of the Ryan Park soil is moderately rapid. 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 severe.

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

The potential plant community on this unit is mainly needleandthread, thickspike wheatgrass, Indian ricegrass, silver sagebrush, and threadleaf sedge. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock in the Carmody soil and the potential for seepage losses. It is moderately well suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope to reduce the hazard of water erosion. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

137—Cathedral-Spinekop-Rock outcrop complex, 0 to 40 percent slopes.

This map unit is on mountains. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 12 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Cathedral gravelly sandy loam, 20 percent Spinekop sandy loam, and 20 percent Rock outcrop. The Cathedral soil occurs on mountain slopes with slopes of 20 to 40 percent. The Spinekop soil occurs in saddles and swales with slopes of 0 to 10 percent. The components of this unit are so intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Boyle gravelly sandy loam, Forelle sandy loam, and Dalecreek sandy loam. Included areas make up about 10 percent of the total acreage.

The Cathedral soil is shallow and well drained. It formed in colluvium and residuum derived from granite. Typically the surface is 40 percent covered with gravel. The surface layer is brown gravelly sandy loam 7 inches thick. The underlying material is brown very gravelly sandy loam 9 inches thick. Hard granite is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Cathedral soil is rapid. 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 moderate.

The Spinekop soil is very deep and well drained. It formed in alluvium. Typically the surface layer is grayish brown sandy loam 2 inches thick. The upper part of the subsoil is pale brown silty clay loam 29 inches thick. The lower part is brown very fine sandy loam to a depth of 60 inches or more.

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

Rock outcrop consists of exposures of highly weathered granite saprolite and nearly vertical hard granite blocks.

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

The potential plant community on the Cathedral soil is bluebunch wheatgrass, needleandthread, little bluestem, and blue grama. As the range condition deteriorates, threeawn, juniper, and blue grama increase. As the range condition further deteriorates, broom snakeweed, cheatgrass, and annual forbs invade. The potential plant community produces about 600 pounds of air-dry vegetation per acre in normal years. Production ranges from 900 pounds in favorable years to 300 pounds in unfavorable years.

The potential plant community on the Spinekop soil is mainly western wheatgrass, needleandthread, and blue grama. As the ecological condition deteriorates, blue grama and threadleaf sedge increase. As the ecological condition further deteriorates, broom snakeweed and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,800 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the droughtiness of the Cathedral soil.

The Cathedral soil is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope. The Spinekop soil is

moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. It is moderately well suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of the Spinekop soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

The Cathedral soil is in capability subclass VIIe, nonirrigated. The Spinekop soil is in capability subclass IVe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Cathedral soil is in the Very Shallow, 12- to 14-inch precipitation, Southern Plains range site and the Spinekop soil is in the Loamy, 12- to 14-inch precipitation, Southern Plains range site. Areas of this map unit at the higher elevations are in similar range sites in the 15- to 19-inch precipitation Foothills and Mountains, Southeast zone.

138—Center Creek loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained soil is on low stream terraces adjacent to major streams. It formed in alluvium. The native vegetation consists mainly of grasses and sedges. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Gerrard loam, Redrob loam, and a soil similar to the Center Creek soil but which has sand and gravel at a depth of 20 to 32 inches. Included areas make up about 25 percent of the total acreage.

Typically the surface layer is dark grayish brown loam 3 inches thick. The upper part of the subsoil is dark grayish brown and brown clay loam 27 inches thick. The lower part is brown loam 7 inches thick. The substratum is yellowish brown very gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Center Creek soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 24 to 48 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal water table is at a depth of 2 to 4 feet from April through August. This soil is subject to a rare hazard of flooding.

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

This unit is well suited for hay and pasture. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on this unit is mainly basin wildrye, tufted hairgrass, and western wheatgrass. As the range condition deteriorates, sedges and rabbitbrush increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 3,700 pounds of air-dry vegetation per acre in normal years. Production ranges from 4,300 pounds in favorable years to 3,000 pounds in unfavorable years.

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

This soil is well suited to the production of vegetation suitable for livestock grazing. The wetness of the soil, however, influences the composition of the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This soil is moderately well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock during the time of the year when the water table is at its highest level. Because of the seepage potential of the substratum of the soil, pits or other types of ponds will not hold water above the level of the water table for long periods of time.

This soil is moderately well suited for mechanical range renovation and range seeding; the main limitation is wetness. Use of mechanical equipment on this soil is limited to the time of the year when the water table is the deepest. If range seedings are planned, plant species should be carefully selected because of the wetness of the soil.

This unit is in capability subclass IVw, nonirrigated and irrigated. It is in the Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site.

139—Chaperton, moderately saline-Blazon complex, 8 to 20 percent slopes.

This map unit is on ridges. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Chaperton loam, moderately saline, and 40 percent Blazon 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 Delphill clay loam, Diamondville fine sandy loam, Forelle loam, and Poposhia loam. Also included are areas of Rock outcrop and reddish soils similar to the Chaperton and Blazon soils. Included areas make up about 15 percent of the total acreage.

The Chaperton soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from shale. Typically the surface is 25 percent covered with about 20 percent igneous gravel and 5 percent cobbles. The surface layer is yellowish brown loam about 4 inches thick. The subsoil is yellowish brown loam about 12 inches thick. The substratum is slightly saline, yellowish brown loam about 19 inches thick. Weakly consolidated shale is at a depth of 35 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Chaperton 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 Blazon soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from shale. Typically 30 percent of the surface is covered with gravel and cobbles. The surface layer is light brownish gray clay loam 2 inches thick. The subsoil is light brownish gray clay loam 5 inches thick. The substratum is light yellowish brown clay loam 9 inches thick. Weakly consolidated gypsiferous shale is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blazon 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 severe. The hazard of wind erosion is moderate.

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

The potential plant community on the Chaperton soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, gardner saltbush, birdfoot sagebrush, and big sagebrush. As the range condition deteriorates, blue grama, sagebrush, and saltbush increase. As the range condition further deteriorates, foxtail barley and

annual grasses and weeds invade. The potential plant community produces about 700 pounds of air-dry vegetation per acre in normal years. Production ranges from 900 pounds in favorable years to 500 pounds in unfavorable years.

The potential plant community on the Blazon soil is mainly western wheatgrass, bluebunch wheatgrass, bottlebrush squirreltail, mutton bluegrass, and winterfat. As the range condition deteriorates, shorter grasses and sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,000 pounds in favorable years to 500 pounds in unfavorable years.

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

Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation, the salinity of the Chaperton soil, and by the droughtiness of the Blazon soil.

This unit is poorly suited for stockwater ponds due to the steepness of slope and the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the hazard of water erosion, salinity of the Chaperton soil, and the droughtiness of the Blazon soil.

The Chaperton soil is in capability subclass VIe, nonirrigated. The Blazon soil is in capability subclass VIIe, nonirrigated. The Chaperton soil is in the Saline Loamy, 10- to 14-inch precipitation, High Plains Southeast range site and the Blazon soil is in the Shallow Clayey, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Platte County and Highway 34 are in similar range sites in the 12- to 14-inch precipitation Southern Plains zone.

140—Chaperton-Poposhia complex, 3 to 30 percent slopes.

This map unit is on ridges. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Chaperton cobbly sandy loam and 30 percent Poposhia very cobbly 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 Blazon loam, Diamonkit sandy loam, Luhon loam, and Stunner sandy loam. Also included are small areas of Browline very gravelly fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Chaperton soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from interbedded sandstone and shale. Typically the surface is 35 percent covered with cobbles and gravel. The surface layer is brown cobbly sandy loam 1 inch thick. The upper part of the subsoil is yellowish brown clay loam 9 inches thick. The lower part is light gray clay loam 18 inches thick. Weakly consolidated shale is at a depth of 28 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Chaperton 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 slight.

The Poposhia soil is very deep and well drained. It formed in alluvium. Typically the surface is 40 percent covered with 15 percent cobbles and 25 percent gravel. The surface layer is yellowish brown very cobbly sandy loam 1 inch thick. The upper part of the subsoil is pale brown loam 6 inches thick. The lower part is pale brown clay loam and yellowish brown sandy clay loam 27 inches thick. The substratum is light yellowish brown clay loam to a depth of 60 inches or more.

Permeability of the Poposhia 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.

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

The potential plant community on this unit is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, black sagebrush, and mutton bluegrass. As the range condition deteriorates, prairie junegrass and big sagebrush increase. As the range condition further deteriorates, annual forbs or grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock in the Chaperton soil and the steepness of slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the cobbly surface layer of the Chaperton soil and the hazard of water erosion.

This unit is in capability subclass VIe, nonirrigated. It is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Included are small areas of the Gravelly, 10- to 14-inch precipitation, High Plains Southeast range site.

141—Cheadle-Passcreek, cobbly subsoil-Rock outcrop complex, 5 to 25 percent slopes.

This map unit is on cuesta dip slopes and canyon sides. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 35 percent Cheadle cobbly very fine sandy loam; 25 percent Passcreek fine sandy loam, cobbly subsoil; 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 Cheadle sandy loam, Miracle fine sandy loam, Nathale gravelly fine sandy loam, and Rimton very fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Cheadle soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from limestone. Typically the surface layer is brown cobbly very fine sandy loam 3 inches thick. The upper 4 inches of the subsoil are dark brown very cobbly very fine sandy loam. The lower 3 inches are brown very cobbly sandy loam. Hard limestone is at a depth of 10 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Cheadle soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is medium and the hazard of water erosion is severe. The hazard of wind erosion is moderate. Winter winds remove the snow from the surface of this soil.

The Passcreek soil is moderately deep and well drained. It formed in residuum and colluvium derived

dominantly from limestone. Typically the surface layer is brown fine sandy loam 4 inches thick. The upper part of the subsoil is brown sandy clay loam 7 inches thick. The lower part is brown and light yellowish brown very cobbly fine sandy loam 11 inches thick. Hard limestone is at a depth of 22 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Passcreek soil is moderate. Available water capacity is very 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 severe. Winter winds remove the snow from the surface of this soil.

Rock outcrop consists of exposures of limestone and of interbedded lenses of sandstone.

This unit is used as rangeland and for wildlife habitat. It is also used for recreation.

The potential plant community on the Cheadle soil is mainly true mountainmahogany, bluebunch wheatgrass, needleandthread, antelope bitterbrush, and spike fescue. As the range condition deteriorates, threadleaf sedge and juniper increase. As the range condition further deteriorates, broom snakeweed, cactus, grasses, and forbs invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,150 pounds in favorable years to 550 pounds in unfavorable years.

The potential plant community on the Passcreek soil is mainly bluebunch wheatgrass, prairie junegrass, sagebrush, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Cheadle soil is limited by the droughtiness of the soil. The Passcreek soil is well suited to the production.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the steepness of slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the hazard of water erosion, the cobbly surface layer and droughtiness of the Cheadle soil, and the presence of Rock outcrop.

The Cheadle soil is in capability subclass VIIe, nonirrigated. The Passcreek soil is in capability subclass VIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Cheadle soil is in the Rocky Hills, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site; and the Passcreek, cobbly subsoil soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

142—Cheadle-Rock outcrop-Miracle complex, 5 to 40 percent slopes.

This map unit is on ridges and cuesta escarpments. The native vegetation consists mainly of grasses, shrubs, and a few scattered trees. Elevation is 7,700 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 40 percent Cheadle sandy loam, 25 percent Rock outcrop, and 20 percent Miracle 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 Passcreek fine sandy loam, cobbly subsoil. Also included is a soil similar to the Miracle soil, but with bedrock deeper than 60 inches. Included areas make up about 15 percent of the total acreage.

The Cheadle soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from sandstone and limestone. Typically the surface layer is brown sandy loam 4 inches thick. The subsoil is brown very cobbly sandy loam 6 inches thick. Hard reddish sandstone is at a depth of 10 inches. Depth to bedrock ranges from 10 to 20 inches. This soil is outside the characteristics of the Cheadle series because it does not have a horizon which contains an accumulation of calcium carbonate. This difference, however, does not significantly affect the use or management of this soil.

Permeability of the Cheadle soil is moderately rapid. 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 severe. Winter winds remove the snow from the surface of this soil.

Rock outcrop consists of exposures of reddish sandstone and interbedded limestone.

The Miracle soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from reddish sandstone and limestone. Typically the surface layer is dark reddish gray and reddish brown fine sandy loam 12 inches thick. The upper part of the subsoil is reddish brown sandy clay loam 12 inches thick. The

lower part is reddish brown sandy loam 14 inches thick. Hard sandstone is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Miracle soil is moderate. Available water capacity is low. 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 severe. Winter winds remove the snow from the surface of this soil.

This unit is used as rangeland, for wildlife habitat, and for recreation.

The potential plant community on the Cheadle soil is mainly bluebunch wheatgrass, threetip sagebrush, black sagebrush, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Miracle soil is mainly bluebunch wheatgrass, Griffith wheatgrass, prairie junegrass, big sagebrush, threetip sagebrush, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Cheadle soil is limited by the droughtiness of the soil. The Miracle soil is well suited to the production.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the steepness of slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the hazard of water erosion, the droughtiness of the Cheadle soil, and the presence of Rock outcrop.

The Cheadle and Miracle soils are in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Cheadle soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site; the Miracle soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

143—Cryaquolls, 1 to 9 percent slopes.

This map unit is in drainageways of foothills near the Medicine Bow Range. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,200 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

Included in this unit are small areas of Granile gravelly sandy loam, Hanson gravelly sandy loam, and Leavitt sandy loam. Also included are small areas of Cryoborolls soils. Included areas make up about 30 percent of the total acreage.

The Cryaquolls soil is very deep and poorly drained. It formed in alluvium. These soils are highly variable within short distances; no single profile is typical. Commonly, the surface is covered with a very dark grayish brown organic mat 3 to 6 inches thick. The surface layer is commonly dark gray loam or gray gravelly loam 10 to 30 inches thick. The next layer is commonly light olive gray or light brownish gray sandy loam, sandy clay loam, or clay loam and may be cobbly, very cobbly, or very stony. This layer is 10 to 20 inches thick. The underlying material is commonly light gray very cobbly sandy loam or extremely gravelly loamy sand to a depth of 60 inches or more. Some pedons have sand and gravel above 40 inches.

Permeability of the Cryaquolls soil is moderate to moderately rapid. Available water capacity is moderate to high. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 5 to 18 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. A seasonal high water table is at a depth of 0 and 1.5 feet from March through August. These soils are subject to frequent, brief seasonal and flash flooding.

This unit is used mainly as rangeland. It is also used for wildlife habitat.

The potential plant community on this soil is mainly tufted hairgrass, Nebraska sedge, slough sedge, and willows. As the range condition deteriorates, willows, sedges, and arrowgrass increase. As the range condition further deteriorates, annuals invade. The potential plant community produces about 5,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 6,500 pounds in favorable years to 4,000 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This soil is well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock. This soil is poorly suited for mechanical range renovation and range seeding; the main limitation is wetness. Use of mechanical equipment on this soil is limited to the time of the year when the water table is the deepest. If range seedings are planned, plant species should be carefully selected because of the wetness of the soil.

This unit is in capability subclass VIw, nonirrigated. It is in the Wetland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

144—Cryoborolls, 6 to 30 percent slopes.

This map unit is in mountain and foothill valleys. The native vegetation consists mainly of aspen trees with a few conifers. Elevation is 7,400 to 8,200 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

Included in this unit are small areas of poorly drained soils and soils with thinner surface layers. Included areas make up about 15 percent of the total acreage.

The Cryoborolls soil is very deep, and well to somewhat poorly drained. It formed in alluvium. These soils are highly variable within short distances; no single profile is typical. Commonly, the surface is covered a layer of aspen leaves and twig litter. The upper part of the surface layer is commonly grayish brown to very dark gray sandy loam, loam, or clay loam 10 to 26 inches thick. The subsoil is commonly yellowish brown or pale brown sandy loam, loam, or clay loam to a depth of 60 inches or more.

Permeability of the Cryoborolls soil is moderate to moderately rapid. Available water capacity is moderate to high. Effective rooting depth and depth to the water table is commonly 60 inches or more, but may be as shallow as 30 inches in areas with impeded drainage. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used mainly for wildlife habitat and for livestock grazing. A few small areas are used for forest wood products.

The present plant community is mainly aspen with an understory of elk sedge, low sedge, bluegrasses, Columbia needlegrass, currant, gooseberry, snowberry, creeping juniper, bedstraw, spike fescue, kinnikinnick, strawberry, violet, rose pussytoes, Richardson's geranium, Rocky Mountain maple, Woods rose, western yarrow, Oregon grape, heartleaf arnica, cinquefoil, larkspur, lupine, and big sagebrush.

This unit is well suited to the production of vegetation suitable for livestock grazing. The tree canopy cover,

however, influences the composition of the plant community.

Because of the variability of the soils within short distances and from area to area, an onsite investigation is necessary to determine the suitability for stockwater ponds.

This unit is moderately suited to the harvesting of aspen wood products. Production of aspen is about 20 to 30 cubic feet per acre per year. Harvesting of the trees is moderately limited because of the steepness of slope and seasonal wetness.

This unit is in capability subclass VIe, nonirrigated. It is in an aspen woodland site.

145—Cushool-Cutback complex, 2 to 10 percent slopes.

This map unit is on pediments to the Laramie Range. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Cushool sandy loam and 35 percent Cutback 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 Bateson sandy clay loam, Forelle loam, Pinelli loam, and Rock River sandy loam. Included areas make up about 25 percent of the total acreage.

The Cushool soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from sedimentary rocks. Typically the surface layer is light brownish gray sandy loam 3 inches thick. The subsoil is pale brown and light brownish gray sandy clay loam 13 inches thick. The substratum is very pale brown gravelly sandy loam about 16 inches thick. Weakly consolidated sandstone is at a depth of 32 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Cushool 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 severe.

The Cutback soil is moderately deep and well drained. It formed in alluvium and residuum derived from conglomerate and tuff. Typically the surface is partly covered with some gravel and a few cobbles. The surface layer is pale brown fine sandy loam 1 inch thick. The upper part of the subsoil is yellowish brown sandy clay loam 6 inches thick. The next part is very pale brown clay loam 10 inches thick. The lower part is yellowish brown extremely gravelly sandy clay loam and light olive brown

very gravelly sandy loam 14 inches thick. Weakly consolidated sandstone is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Cutback 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 severe.

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

The potential plant community on the Cushool soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Cutback soil is mainly western wheatgrass, bluebunch wheatgrass, mutton bluegrass, needleandthread, and black sagebrush. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the seepage potential. It is moderately well suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. The Cushool soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site and the Cutback soil is

in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

146—Cushool-Diamondville fine sandy loams, 0 to 3 percent slopes.

This map unit is on hill crests. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Cushool soil and 35 percent Diamondville soil. 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 Alcovia sandy loam, Forelle loam, and Stunner fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Cushool soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from sandstone. Typically the surface layer is grayish brown fine sandy loam 2 inches thick. The upper part of the subsoil is brown sandy clay loam 11 inches thick. The next 3 inches are yellowish brown sandy clay loam. The lower part is brown sandy loam 16 inches thick. Weakly consolidated sandstone is at a depth of 32 inches. Depth to bedrock ranges from 20 to 40 inches.

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

The Diamondville soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from interbedded shale and sandstone. Typically the surface layer is brown fine sandy loam 8 inches thick. The upper part of the subsoil is yellowish brown clay loam 12 inches thick. The lower part is light yellowish loam 18 inches thick. Weakly consolidated shale is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

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

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

The potential plant community on this unit is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush, rabbitbrush, and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant

community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

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

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVs, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

147—Cutback-Pinelli complex, 1 to 25 percent slopes.

This map unit is on pediments to the Laramie Range. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Cutback gravelly sandy clay loam, 1 to 25 percent slopes and 30 percent Pinelli loam, 1 to 8 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Chalkville loam, Chalkhill sandy loam, and Rock River fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Cutback soil is moderately deep and well drained. It formed in alluvium and in residuum derived dominantly from conglomerate and tuff. Typically the surface is 30 percent covered with fine and medium gravel. The surface layer is pale brown gravelly sandy clay loam 2 inches thick. The upper part of the subsoil is light brown sandy clay loam 8 inches thick. The next part is very pale brown

very gravelly sandy loam 10 inches thick. The lower part is white very gravelly loamy sand 13 inches thick. Weakly consolidated tuffaceous sandstone is at a depth of 37 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Cutback soil is moderate. Available water capacity is very 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 Pinelli soil is very deep and well drained. It formed in alluvium derived dominantly from sedimentary rock. Typically the surface layer is dark brown loam 2 inches thick. The upper part of the subsoil is brown clay loam 15 inches thick. The next part is white clay loam 25 inches thick. The lower part is light gray clay loam to a depth of 60 inches or more.

Permeability of the Pinelli 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 slight. The hazard of wind erosion is moderate.

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

The potential plant community on the Cutback soil is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, mutton bluegrass, and black sagebrush. As the range condition deteriorates, blue grama, threadleaf sedge, and black sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Pinelli soil is mainly western wheatgrass, bluebunch wheatgrass, and big sagebrush. As the range condition deteriorates, big sagebrush increases. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

The Cutback soil is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is poorly suited for mechanical range renovation and range

seeding; the main limitations are the hazard of water erosion and the gravelly surface layer.

The Pinelli soil is moderately well suited for stockwater ponds, mechanical range renovation, and range seeding. The main limitation for stockwater ponds is the steepness of slope. The main limitation for mechanical range renovation and range seeding is the hazard of water erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of water erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Tillage should be along the contour of the slope. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

The Cutback is in capability subclass VIe, nonirrigated. The Pinelli soil is in capability subclass IVe, nonirrigated. The Cutback is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Pinelli soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

148—Dahlquist-Rawlins-Browtine complex, moist, 3 to 15 percent slopes.

This map unit is on fan terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Dahlquist very gravelly sandy loam, 30 percent Rawlins sandy loam, and 20 percent Browtine very cobbly sandy loam. The Dahlquist and Rawlins soils are on slopes of 3 to 8 percent. The Browtine soil is on slopes of 6 to 15 percent. 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 Anchutz sandy loam, McFadden gravelly fine sandy loam, Rock River sandy loam, and Stunner sandy loam. Included areas make up about 15 percent of the total acreage.

The Dahlquist soil is very deep and well drained. It formed in alluvium. Typically the surface is 20 percent covered with coarse gravel and fine cobbles. The surface layer is light brownish gray very gravelly sandy loam 2 inches thick. The upper 13 inches of the subsoil are yellowish brown very cobbly sandy clay loam. The next 5 inches are brownish yellow very gravelly sandy clay loam.

The lower part is light yellowish brown very gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Dahlquist soil is moderate in the upper part of the subsoil and rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium and the hazard of water erosion is slight. The hazard of wind erosion is slight.

The Rawlins soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown sandy loam 2 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam 7 inches thick. The next part is pale yellow very fine sandy loam 9 inches thick. The lower part is pale yellow and yellow fine sandy loam to a depth of 60 inches or more.

Permeability of the Rawlins 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 severe.

The Browtine soil is very deep and well drained. It formed in alluvium. Typically the surface is 20 percent covered with coarse gravel and fine cobbles. The surface layer is grayish brown very cobbly sandy loam 10 inches thick. The upper part of the subsoil is pale yellow very cobbly sandy loam 8 inches thick. The next part is light gray very cobbly sandy loam 14 inches thick. The lower part is pale yellow gravelly clay loam to a depth of 60 inches or more.

Permeability of the Browtine soil is moderately rapid in the upper part of the subsoil and moderately slow in the lower part. Available water capacity is moderate. Effective rooting depth is 15 to 25 inches because carbonates restrict growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight.

This unit is used mainly as rangeland or for wildlife habitat. A few small areas are used for irrigated hay.

If this unit is used for hay and pasture, the main limitations are the cobbles on the surface and the droughtiness of the Dahlquist and Browtine soils; the steepness of slope is also a limitation. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Frequent applications of irrigation water will be necessary because of the limited available water capacity of the soils. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, prairie junegrass, and western wheatgrass. As the range condition deteriorates, blue grama and sagebrush increase. As the range condition further deteriorates, broom snakeweed,

curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,700 pounds in favorable years to 800 pounds in unfavorable years.

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

Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the potential for seepage losses. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the gravel and cobbles in the surface layers of the Dahlquist and Browtine soils.

The Dahlquist and Browtine soils are in capability subclass VI_s, nonirrigated and irrigated. The Rawlins soil is in capability subclass IV_e, nonirrigated and irrigated. This unit is in the Coarse Upland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

149—Dalecreek-Kovich complex, 0 to 9 percent slopes.

This map unit is on flood plains and in valleys of mountainous areas. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 55 percent Dalecreek sandy loam, 0 to 9 percent slopes, and 30 percent Kovich loam, 0 to 3 percent slopes. The Dalecreek soil is on the higher areas of the flood plains and valley bottoms. The Kovich soil is on the lower areas of the flood plains and valley bottoms. 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 Canburn loam and of Lininger loam. Also included are small areas of a very deep, well drained, very gravelly, loamy soil. Included areas make up about 15 percent of the total acreage.

The Dalecreek soil is very deep and moderately well drained. It formed in alluvium derived dominantly from granite. Typically the surface layer is dark grayish brown sandy loam 8 inches thick. The subsoil is very dark

grayish brown and gray loam 24 inches thick. The substratum to a depth of 60 inches or more is gray sandy clay loam stratified with thin lenses of loamy coarse sand.

Permeability of the Dalecreek soil is moderate. Available water capacity is high. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is severe. Effective rooting depth is 60 inches for water-tolerant plants, but it is only 30 to 48 inches for plants that cannot tolerate a water table. A seasonal high water table fluctuates between depths of 2.5 and 4 feet from April through July. This soil is subject to a rare hazard of flooding.

The Kovich soil is very deep and poorly drained. It formed in alluvium derived dominantly from granite. Typically the surface layer is dark brown loam 8 inches thick. The next 23 inches are very dark grayish brown loam. The underlying material, to a depth of 60 inches or more, is stratified grayish brown gravelly sandy clay loam, loam, sandy loam, and gravelly sand.

Permeability of the Kovich soil is moderate. Available water capacity is high. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 5 to 30 inches for plants that cannot tolerate a high water table. A seasonal high water table is at a depth of 0 to 3 feet from April through August. This soil is subject to brief, occasional flooding from April through July.

This unit is used for irrigated hay, as rangeland, and for wildlife habitat.

If this unit is used for hay and pasture, the main limitations are the short growing season and the wetness of the Kovich soil. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Dalecreek soil is mainly basin wildrye, tufted hairgrass, slender wheatgrass, and western wheatgrass. As the range condition deteriorates, low-growing sedges, shrubby cinquefoil, rubber rabbitbrush, and willows increase. As

the range condition further deteriorates, annual forbs invade. The potential plant community produces about 4,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 4,500 pounds in favorable years to 3,300 pounds in unfavorable years.

The potential plant community on the Kovich soil is mainly tufted hairgrass, Nebraska sedge, slough sedge, and willows. As the range condition deteriorates, willows increase. As the range condition further deteriorates, rushes, sedges, and annual forbs invade. The potential plant community produces about 5,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 6,500 pounds in favorable years to 4,000 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while 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 Dalecreek soil is well suited to the production of vegetation suitable for livestock grazing. Production of vegetation on the Kovich soil is limited by wetness. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock. Because the water table is at a more shallow depth in the Kovich soil, it is better suited for these pits than the Dalecreek soil. The Kovich soil is poorly suited for mechanical range renovation and range seeding; the main limitation is wetness. Use of mechanical equipment on the Kovich soil is limited due to wetness. If range seedings are planned, plant species should be carefully selected because of the wetness of the soil.

The Dalecreek soil is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

The Dalecreek soil is in capability subclass IVw, irrigated and nonirrigated. The Kovich soil is in capability subclass Vw, irrigated and nonirrigated. The Dalecreek soil is in the Subirrigated, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Kovich soil is in the Wetland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. Areas of this map unit near the Platte County line near Highway 34 are in the 12- to 14-inch precipitation, Southern Plains range site zone.

150—Delphill-Blazon complex, 3 to 20 percent slopes.

This map unit is on hills and ridges. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is 45 percent Delphill loam and 35 percent Blazon 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 Chaperton loam, Diamondville fine sandy loam, and Poposhia loam. Also included are small areas of Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Delphill soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from shale and sandstone. Typically the surface layer is light yellowish brown loam 1 inch thick. The underlying material is yellowish brown and very pale brown clay loam 20 inches thick. Weakly consolidated shale is at a depth of 21 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Delphill soil is moderate. Available water capacity is low. 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 Blazon soil is shallow and well drained. It formed in residuum and alluvium derived dominantly from shale and sandstone. Typically the surface layer is olive clay loam about 2 inches thick. The underlying material is olive clay loam 9 inches thick. Weakly consolidated shale is at a depth of 11 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blazon 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 severe. The hazard of wind erosion is moderate.

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

The potential plant community on the Delphill soil is mainly western wheatgrass, needleandthread, bluebunch wheatgrass, and big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. The Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Blazon soil is mainly bluebunch wheatgrass, western wheatgrass, mutton bluegrass, bottlebrush squirreltail, and winterfat.

As the range condition deteriorates, Sandberg bluegrass and big sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,000 pounds in favorable years to 500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation on the Delphill soil suitable for livestock grazing is moderately limited by the low annual precipitation. Production of vegetation on the Blazon soil is moderately limited by the droughtiness of the soil and by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the slope and the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the hazard of water erosion and the droughtiness of the Blazon soil. Tillage for range improvement is not recommended. Interseeding and seedbed preparation by band spraying of herbicides can be used. Mechanical range renovation may not be practical in some areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

The Delphill soil is in capability subclass VIe, nonirrigated. The Blazon soil is in capability subclass VIIe, nonirrigated. The Delphill soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Blazon soil is in the Shallow Clayey, 10- to 14-inch precipitation, High Plains Southeast range site.

151—Diamondville-Cushool complex, 3 to 15 percent slopes.

This map unit is on hills and ridges. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Diamondville fine sandy loam and 40 percent Cushool 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 Blazon loam, Forelle loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Diamondville soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from shale and sandstone. Typically the surface layer is pale brown fine sandy loam 6 inches thick. The upper 12 inches of the subsoil are pale brown loam. The next 4 inches are very pale brown loam. The lower part is very pale brown fine sandy loam 13 inches thick. Weakly consolidated interbedded sandstone and shale are at a depth of 35 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Diamondville 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 severe.

The Cushool soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from interbedded sandstone and shale. Typically the surface layer is pale brown sandy loam 3 inches thick. The upper part of the subsoil is light yellowish brown and very pale brown sandy clay loam about 12 inches thick. The lower part is very pale brown fine sandy loam 13 inches thick. Weakly consolidated sandstone is at a depth of 28 inches. Depth to bedrock ranges from 20 to 40 inches. In some areas, the lower part of the subsoil is gravelly.

Permeability of the Cushool 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Diamondville soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Cushool soil is mainly needleandthread, thickspike wheatgrass, and Indian ricegrass. As the range condition deteriorates, sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance

of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. It is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. To reduce the hazards of wind and water erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope. Mechanical range renovation may not be practical in some areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. The Diamondville soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site and the Cushool soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone.

152—Diamonkit-Stylite sandy loams, 3 to 15 percent slopes.

This map unit is on hillslopes. The native vegetation consists mainly of grasses and some shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Diamonkit sandy loam, 3 to 15 percent slopes; and 35 percent Stylite sandy loam, 3 to 8 percent slopes. The components of this unit are so intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Forelle loam and Rock River sandy loam. Included areas make up about 25 percent of the total acreage.

The Diamonkit soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from interbedded gypsiferous sedimentary rock. Typically the surface layer is light yellowish brown sandy loam 1 inch thick. The upper part of the subsoil is yellowish brown and light yellowish brown sandy clay loam 10 inches thick. The lower part is light yellowish brown loam and grayish brown clay loam 22 inches thick; it contains common medium filaments, threads, and soft masses of gypsum. Weakly consolidated interbedded

gypsiferous shale and sandstone are at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Diamonkit 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 severe.

The Stylite soil is very deep and well drained. It formed in alluvium and residuum derived dominantly from gypsiferous sedimentary rock. Typically the surface layer is light olive brown sandy loam 2 inches thick. The upper 12 inches of the subsoil are light brownish gray loam. The next 17 inches are light yellowish brown loam and contains a high amount of calcium carbonate. The lower part to a depth of 60 inches or more is light yellowish brown loam and contains many soft masses of gypsum.

Permeability of the Stylite 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 severe.

This unit is used mainly as rangeland. It is also used for wildlife habitat.

The potential plant community on the Diamonkit soil is mainly bluebunch wheatgrass, western wheatgrass, mutton bluegrass, black sagebrush, and needleandthread. As the range condition deteriorates, bluegrasses, sagebrush, and sedges increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Stylite soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush, rabbitbrush, and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The vegetative production and plant communities vary slightly in some areas. This is due to the variable amounts of gypsum and other salts in these soils.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing should be managed to protect the unit from excessive erosion.

Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the alkalinity of the Stylite soil.

This unit is poorly suited for stockwater ponds because of the depth to bedrock in the Diamonkit soil and the potential for seepage caused by piping.

This unit is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazards of wind and water erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This map unit is in capability subclass IVe, nonirrigated. The Diamonkit soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Stylite soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Platte County near Highway 34 are in similar range sites in the 12- to 14-inch precipitation Southern Plains zone.

153—Elkol clay loam, 0 to 8 percent slopes.

This soil is very deep and well drained. It formed in alluvium. This unit is on stream terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Gerdrum Family loam, Kiltabar silty clay loam, and Tisworth loam. Included areas make up about 15 percent of the total acreage.

Typically the surface layer is brown clay loam 3 inches thick. The upper 31 inches of the underlying material is light olive brown and light yellowish brown clay. The lower part to a depth of 60 inches or more is light olive brown clay loam. This soil is slightly saline and strongly alkaline in all layers.

Permeability of the Elkol 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 slight. The hazard of wind erosion is moderate.

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

The potential plant community on this unit is mainly western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and gardner saltbush. As the range condition deteriorates, shrubs increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 650 pounds in favorable years to 300 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the salinity and alkalinity of the soil.

This soil is well suited for stockwater ponds. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the salinity and alkalinity of the soil. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity and alkalinity of the soil. The low annual precipitation should also be of concern when planning range seedings.

This unit is in capability subclass VI_s, nonirrigated. It is in the Saline Upland, 10- to 14-inch precipitation, High Plains Southeast range site.

154—Elkol-Gerdrum Family complex, 1 to 8 percent slopes.

This map unit is on stream terraces and on hillslopes adjoining playa lakes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Elkol silty clay loam, 1 to 3 percent slopes and 25 percent Gerdrum Family loam, 3 to 8 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blazon loam, Diamondville fine sandy loam, Forelle loam, and Tisworth loam. Also included are areas of clay dunes. Included areas make up about 25 percent of the total acreage.

The Elkol soil is very deep and well drained. It formed in alluvium. Typically the surface layer is yellowish brown strongly alkaline silty clay loam 2 inches thick. The upper 28 inches of the underlying material is light olive brown and yellowish brown strongly alkaline silty clay loam. The lower part to a depth of 60 inches or more is light

yellowish brown moderately alkaline sandy clay loam. This soil is slightly saline in all layers.

Permeability of the Elkol 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.

The Gerdrum Family soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown loam 1 inch thick. The upper 15 inches of the subsoil are light yellowish brown strongly alkaline silty clay loam. The next 15 inches are yellowish brown strongly alkaline silty clay loam. The lower part is light yellowish brown moderately alkaline silty clay loam to a depth of 60 inches or more. This soil is moderately saline in all layers below a depth of 16 inches.

Permeability of the Gerdrum Family soil is very 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 mainly as rangeland and for wildlife habitat.

The potential plant community on the Elkol soil is mainly alkali sacaton, basin wildrye, inland saltgrass, black greasewood, and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

The potential plant community on the Gerdrum Family soil is mainly western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and gardner saltbush. As the range condition deteriorates, shrubs increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 650 pounds in favorable years to 300 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the salinity and alkalinity of the soil.

This unit is well suited for stockwater ponds. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the salinity and alkalinity of the soils. If range seedings are planned, seeding rates should be increased and plant species carefully selected

because of the salinity and alkalinity of the soils. The low annual precipitation should also be of concern when planning range seedings.

This unit is in capability subclass VI_s, nonirrigated. The Elkol soil is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site. The Gerdrum Family soil is in the Saline Upland, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone.

155—Elkol-Gerdrum Family, overflow complex, 0 to 3 percent slopes.

This map unit is on stream terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Elkol silty clay loam and 35 percent Gerdrum Family loam, overflow. 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 Bosler sandy loam, Diamondville fine sandy loam, and Tisworth fine sandy loam. Also included are small areas of Borollic Camborthids soils. Included areas make up about 15 percent of the total acreage.

The Elkol soil is very deep and well drained. It formed in alluvium. Typically the surface layer is light olive brown strongly alkaline silty clay loam 5 inches thick. The upper 40 inches of the substratum is olive yellow and light yellowish brown strongly alkaline silty clay loam. The lower part to a depth of 60 inches or more is light olive brown strongly alkaline silty clay. This soil is slightly saline in all layers.

Permeability of the Elkol 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 slight. The hazard of wind erosion is moderate.

The Gerdrum Family soil is very deep and moderately well drained. It formed in alluvium. Typically the surface layer is pale brown loam 2 inches thick. The upper part of the subsoil is olive brown and light yellowish brown strongly alkaline silty clay loam 19 inches thick. The lower part is light yellowish brown strongly alkaline, moderately saline clay loam to a depth of 60 inches or more.

Permeability of the Gerdrum Family soil is very slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. From May through July, a high water table fluctuates between a depth of 4 and 6 feet.

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

The potential plant community on this unit is mainly alkali sacaton, basin wildrye, inland saltgrass, black greasewood, and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation and by the salinity and alkalinity of the soil.

This unit is well suited for stockwater ponds. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the salinity and alkalinity of the soils. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity and alkalinity of the soils. The low annual precipitation should also be of concern when planning range seedings.

This unit is in capability subclass VI_s, nonirrigated. It is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site.

156—Evanston fine sandy loam, 0 to 6 percent slopes.

This very deep, well drained soil is on fan terraces and alluvial fans. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,500 to 6,800 feet. The annual precipitation is 15 to 17 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Forelle loam and Ipson gravelly loam. Included areas make up about 15 percent of the total acreage.

Typically the surface layer is grayish brown fine sandy loam 4 inches thick. The upper part of the subsoil is dark yellowish brown sandy clay loam and yellowish brown clay loam 10 inches thick. The lower part is light yellowish brown and very pale brown loam to a depth of 60 inches or more.

Permeability of the Evanston 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Evanston soil is mainly needleandthread, western wheatgrass, and little bluestem. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and annual grasses invade. The potential plant community produces about 1,400 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,900 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. This soil is well suited to the production of vegetation suitable for livestock grazing.

This soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. It is well suited for mechanical range renovation and range seeding.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 15- to 17-inch precipitation, Southern Plains range site.

157—Evanston-Bonjea complex, 5 to 40 percent slopes.

This map unit is on foothills and on mountain slopes. The native vegetation consists mainly of grasses, shrubs, and a few trees. Elevation is 6,300 to 7,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Evanston loam, 5 to 30 percent slopes and 30 percent Bonjea fine sandy loam, 10 to 40 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Spinekop loam and granitic Rock outcrop. Also included are small areas of a soil similar to the Bonjea soil, but with a sandy loam subsoil; and areas of soil similar to the Evanston soil, but with a thicker surface layer. Included areas make up about 25 percent of the total acreage.

The Evanston soil is very deep and well drained. It formed in alluvium and eolian deposits derived dominantly from tuffaceous sedimentary rock. Typically the surface layer is dark brown loam 7 inches thick. The upper part of the subsoil is brown loam 13 inches thick. The lower part is light brownish gray loam to a depth of 60 inches or more.

Permeability of the Evanston 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 Bonjea soil is shallow and well drained. It formed in residuum and colluvium derived from granite and gneiss. The surface layer is very dark grayish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown gravelly sandy clay loam 10 inches thick. Hard granite is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Bonjea 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 severe. The hazard of wind erosion is severe.

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

The potential plant community on the Evanston soil is mainly bluebunch wheatgrass, prairie junegrass, Griffith wheatgrass, big sagebrush, threetip sagebrush, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Bonjea soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

The Evanston soil is well suited to the production of vegetation suitable for livestock grazing. Production on the Bonjea soil is moderately limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Evanston soil is in capability subclass VIe, nonirrigated. The Bonjea soil is in capability subclass VIIe, nonirrigated. The Evanston soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Bonjea soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

158—Fiveoh-Fiveoh, cobbly substratum-Ryan Park complex, 1 to 8 percent slopes.

This map unit is on alluvial fans and terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 30 percent Fiveoh sandy loam; 30 percent Fiveoh sandy loam, cobbly substratum; and 25 percent Ryan Park 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 Canwall fine sandy loam and Pilotpeak cobbly fine sandy loam. Also included are small areas of sand and gravel bars along drainageways. Included areas make up about 15 percent of the total acreage.

The Fiveoh soil is very deep and well drained. It formed in alluvium derived from limestone and sandstone. Typically the surface layer is yellowish brown sandy loam 6 inches thick. The upper part of the subsoil is brown fine sandy loam 10 inches thick. The lower part is light brown and strong brown fine sandy loam to a depth of 60 inches or more.

Permeability of the Fiveoh 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 soil is subject to gulying during heavy rainstorms.

The Fiveoh, cobbly substratum soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown sandy loam 3 inches thick. The upper part of the subsoil is brown sandy loam 19 inches thick. The next 9 inches are strong brown cobbly sandy loam. The lower part to a depth of 60 inches or more is strong brown very cobbly sandy loam.

Permeability of the Fiveoh, cobbly substratum 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 Ryan Park soil is very deep and well drained. It formed in alluvium. Typically the surface layer is yellowish brown fine sandy loam 3 inches thick. The upper part of

the subsoil is brown fine sandy loam 15 inches thick. The lower part is brown gravelly fine sandy loam and light brown gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Ryan Park soil is moderately rapid. 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly needleandthread, thickspike wheatgrass, Indian ricegrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

159—Fiveoh, cobbly substratum-Fiveoh-Urban land complex, 1 to 5 percent slopes.

This map unit is on terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Fiveoh sandy loam, cobbly substratum; 20 percent Fiveoh sandy loam; and 15 percent Urban land. 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 Almy loam, Rohonda fine sandy loam, and Wycolo sandy loam. Included areas make up about 15 percent of the total acreage.

The Fiveoh, cobbly substratum soil is a very deep and well drained. It formed in alluvium. Typically the surface layer is brown fine sandy loam 3 inches thick. The upper 15 inches of the subsoil are strong brown fine sandy loam. The next 11 inches are light brown gravelly fine sandy loam. The lower part to a depth of 41 inches are reddish yellow fine sandy loam. The substratum is reddish yellow very cobbly sandy loam to a depth of 60 inches or more.

Permeability of the Fiveoh, cobbly substratum 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 Fiveoh soil is a very deep and well drained. It formed in alluvium derived from limestone and sandstone. Typically the surface layer is yellowish brown sandy loam 6 inches thick. The upper part of the subsoil is brown fine sandy loam 10 inches thick. The lower part is light brown and strong brown fine sandy loam to a depth of 60 inches or more.

Permeability of the Fiveoh 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 soil is subject to gulying during heavy rain storms.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

This unit is well suited to urban development. It has few limitations.

The Fiveoh soils are in capability subclass IVe, nonirrigated.

160—Fiveoh, cobbly substratum-Joemre fine sandy loams, 1 to 5 percent slopes.

This map unit is on terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches,

the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 60 percent Fiveoh, cobbly substratum, 1 to 3 percent slopes and 25 percent Joemre fine sandy loam, 2 to 5 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Almy loam, Fiveoh sandy loam, Rohonda fine sandy loam, and Wycolo sandy loam. Included areas make up about 15 percent of the total acreage.

The Fiveoh, cobbly substratum soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown fine sandy loam 3 inches thick. The upper 15 inches of the subsoil are strong brown fine sandy loam. The next 11 inches are light brown gravelly fine sandy loam. The lower part to a depth of 41 inches are reddish yellow fine sandy loam. The lower part is reddish yellow very cobbly sandy loam to a depth of 60 inches or more.

Permeability of the Fiveoh, cobbly substratum 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 Joemre soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown fine sandy loam 4 inches thick. The upper 14 inches of the subsoil are strong brown fine sandy loam. The next part is yellowish red loam 7 inches thick. The lower part is yellowish red loam to a depth of 60 inches or more.

Permeability of the Joemre soil is moderately rapid. 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 severe.

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

The potential plant community on the unit is mainly needleandthread, Indian ricegrass, thickspike wheatgrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years. Areas of this unit near Iron Mountain have a slightly higher production.

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

Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

161—Folavar very gravelly sandy loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained soil is on terraces. It formed in alluvium and was modified by congeliturbation. The native vegetation consists mainly of grasses and sedges. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Gerrard loam and Pahlow gravelly sandy loam. Included areas make up about 25 percent of the total acreage.

Typically the surface is covered with a dense sod layer about 2 inches thick. The surface layer is brown very gravelly sandy loam 3 inches thick. The subsoil is dark yellowish brown very gravelly sandy loam 8 inches thick. The substratum is brown very gravelly loamy sand and extremely gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Folavar soil is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is very low. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 5 to 24 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight. A fluctuating water table between a depth of 0 and 2 feet occurs from April through August. The water table is the result of irrigation. This soil is subject to a rare hazard of flooding.

This unit is used mainly for irrigated hay and pasture and for wildlife habitat.

If this unit is used for hay and pasture, the main limitation is the wetness of the soil. Applications of

irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

This unit is in capability subclass VI, nonirrigated and irrigated.

162—Folavar-Borollic Camborthids complex, 0 to 3 percent slopes.

This map unit is on stream terraces with a mound-intermound pattern of microrelief. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Folavar very gravelly sandy loam and 40 percent Borollic Camborthids soil. The Folavar soil occurs in intermound areas and the Borollic Camborthids soil occurs on the mounds. 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 Pahlow gravelly sandy loam. Also included are small areas of poorly drained soils. Included areas make up about 15 percent of the total acreage.

The Folavar soil is very deep and somewhat poorly drained. It formed in alluvium. Typically the surface is covered with a layer of dense sod 2 inches thick. The surface layer is brown very gravelly sandy loam 5 inches thick. The subsoil is dark yellowish brown gravelly sandy loam 7 inches thick. The substratum is yellowish brown very gravelly loamy sand and extremely gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Folavar soil is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is very low. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 5 to 24 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight. A fluctuating water table at a depth of 0 and 2 feet occurs from April through August. The water

table is the result of irrigation of this soil. This soil is subject to a rare hazard of flooding.

The Borollic Camborthids soil is very deep and moderately well drained. It formed in alluvium. These soils vary from area to area, and no single profile is typical. Commonly, the surface is about 20 percent covered with gravel. The surface layer is commonly brown gravelly sandy loam or very gravelly sandy loam 5 inches thick. The subsoil is commonly yellowish brown or brown very gravelly sandy loam 35 inches thick. The substratum is commonly pale brown very gravelly loamy sand or extremely gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Borollic Camborthids soil is moderately rapid. Available water capacity is very low or low. Effective rooting depth is 60 or more inches. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight. A fluctuating water table is at a depth of 1.5 to 5 feet occurs during the growing season. It is due to irrigation of this soil. This soil is subject to a rare hazard of flooding.

This unit is used mainly for irrigated hay and pasture. It is also used for wildlife habitat.

If this unit is used for hay and pasture, the main limitation are the wetness of the soils and the hummocky terrain. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

This unit is in capability subclass VI, nonirrigated and irrigated.

163—Forelle loam, 0 to 6 percent slopes.

This very deep, well drained soil is on fan aprons. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Cushool sandy loam, Diamondville fine sandy loam, Pinelli clay loam,

and Stunner sandy loam. Also included in drainageways are areas of a soil similar to the Forelle soil, but which receive water from runoff. Included areas make up about 25 percent of the total acreage.

Typically the surface layer is very pale brown loam 2 inches thick. The upper part of the subsoil is yellowish brown clay loam 20 inches thick. The next 14 inches are light brownish gray loam. The lower part to a depth of 60 inches or more is pale brown sandy loam. In some areas, the surface layer and upper part of the subsoil are slightly darker in color.

Permeability of the Forelle 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.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Forelle soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is well suited for mechanical range renovation and range seeding. The low annual precipitation, however, should be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. This unit is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

164—Forelle-Urban land complex, 0 to 3 percent slopes.

This map unit is on terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 60 percent Forelle loam and 25 percent Urban land. 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 Diamondville fine sandy loam and Stunner sandy loam. Also included in this unit are areas that have a seasonal high water table due to irrigation. Included areas make up about 15 percent of the total acreage.

The Forelle soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown loam 5 inches thick. The upper part of the subsoil is yellowish brown clay loam 19 inches thick. The next 11 inches are light brownish gray loam. The lower part to a depth of 60 inches or more is pale brown sandy loam.

Permeability of the Forelle 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.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

The Forelle soil is well suited for urban development. It has few limitations.

The Forelle soil is in capability subclass IVc, nonirrigated.

165—Forelle-Diamondville association, 3 to 15 percent slopes.

This map unit is on hills. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Forelle fine sandy loam, 3 to 8 percent slopes and 35 percent Diamondville fine sandy loam, 6 to 15 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blazon loam, Chaperton cobbly sandy loam, Cushool sandy loam, Pinelli clay loam, and Tisworth sandy clay loam. Included areas make up about 20 percent of the total acreage.

The Forelle soil is very deep and well drained. It formed in alluvium. Typically the surface layer is light brownish gray fine sandy loam 4 inches thick. The upper 3 inches of the subsoil are brown loam. The next 8 inches are

brown clay loam. The lower part is light yellowish brown and pale brown loam to a depth of 60 inches or more.

Permeability of the Forelle 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 severe.

The Diamondville soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from interbedded shale and sandstone. Typically the surface layer is brown fine sandy loam 1 inch thick. The upper part of the subsoil is yellowish brown loam 16 inches thick. The lower part is light yellowish brown and pale brown loam 17 inches thick. Weakly consolidated sandstone is at a depth of 34 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Diamondville 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

The Forelle soil is poorly suited for stockwater ponds due to the potential for seepage losses. The Diamondville soil is poorly suited for stockwater ponds due to the depth to bedrock. This unit is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of water and wind erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be

needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone. Areas of this map unit near Platte County near Highway 34 are in similar range sites the 12- to 14-inch precipitation Southern Plains zone.

166—Glendive-Redrob-Grenoble complex, 0 to 3 percent slopes.

This map unit is on flood plains and low stream terraces. The native vegetation consists mainly of grasses, grass-like plants, willows, and cottonwoods. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Glendive loam, 35 percent Redrob loam, and 15 percent Grenoble gravelly 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 frequently flooded Redrob loam and Riverwash. Also included are small areas of a soil similar to the Glendive soil, but which are loamy textured; and a soil similar to the Redrob soil, but which has a lighter colored surface layer. Included areas make up about 10 percent of the total acreage.

The Glendive soil is very deep and moderately well drained. It formed in alluvium. Typically the surface layer is dark grayish brown and brown loam 6 inches thick. The underlying material to a depth of 60 inches or more is brown and pale brown fine sandy loam stratified with thin layers of dark grayish brown sandy loam and yellowish brown loam.

Permeability of the Glendive soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 36 to 60 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between a depth of 3 and 5 feet from April through August. This soil is subject to a rare hazard of flooding.

The Redrob soil is very deep and poorly drained. It formed in alluvium. Typically the upper part of the surface layer is dark gray and gray loam 9 inches thick. The upper part of the underlying material is light yellowish brown loam and grayish brown sandy loam 10 inches thick. The next part is light yellowish brown very gravelly loam 5

inches thick. The lower part is light yellowish brown extremely gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Redrob soil is moderate in the upper part and very rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches or more for water-tolerant plants, but is 12 to 24 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is slight. The water table fluctuates between a depth of 1 and 2 feet from April through August. This soil is subject to a rare hazard of flooding.

The Grenoble soil is very deep and somewhat poorly drained. It formed in alluvium. Typically the surface layer is brown gravelly sandy loam 9 inches thick. The underlying material is yellowish brown very gravelly sand to a depth of 60 inches or more.

Permeability of the Grenoble soil is very rapid. Available water capacity is very low. Effective rooting is 60 inches or more for plants that can tolerate a water table, but it is 24 to 42 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between depths of 2 to 3.5 feet from March through August. This soil is subject to frequent brief flooding from May through June.

This unit is used mainly as rangeland and for wildlife habitat. In some areas it is also used for hay and pasture.

The potential plant community on the Glendive and Redrob soils is mainly alkali sacaton, basin wildrye, and alkali bluegrass. As the range condition deteriorates, inland salt grass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years.

The potential plant community on the Grenoble soil is mainly alkali sacaton, basin wildrye, inland saltgrass, and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the wetness and salinity of the soils. Grazing

should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is well suited for stockwater ponds. Pits dug sufficiently below the level of the water table can provide water for livestock. The Redrob soil is more suitable for these pits because the water table is at a more shallow depth in this soil than in the other soils. Because of the seepage potential of the lower layers of all the soils in this unit, pits or other types of ponds will not hold water above the level of the water table for a long period of time. This unit is poorly suited for mechanical range renovation and range seeding; the main limitations are wetness and salinity of the soils, and the gravelly surface layer of the Grenoble soil. Use of equipment on this unit is limited to periods when the water table is the deepest. If range seedings are planned, plant species should be carefully selected because of the salinity and the wetness of the soils.

If this unit is used for hay and pasture, the main limitation is the wetness of the soils. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The Glendive and the Redrob soils are in capability subclass IVw, nonirrigated and irrigated. The Grenoble soil is in capability subclass VI, nonirrigated and irrigated. The Glendive and Redrob soils are in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site. The Grenoble soil is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone.

167—Grenoble-Gerrard complex, 0 to 3 percent slopes.

This map unit is on flood plains and low stream terraces. The native vegetation consists mainly of willows, forbs, grasses, and sedges. Elevation is 6,000 to 7,500

feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Grenoble gravelly loamy sand, 1 to 3 percent slopes and 30 percent Gerrard loam, 0 to 2 percent slopes. The Grenoble soil is on gravel bar remnants. The Gerrard soil is in abandoned meandering stream channels. 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 Glendive sandy loam, frequently flooded Redrob loam, and Riverwash. Also included are soils with a 12- to 24-inch-thick peat layer overlying sand and gravel. Included areas make up about 30 percent of the total acreage.

The Grenoble soil is very deep and somewhat poorly drained. It formed in alluvium. Typically the surface is covered with a 1-inch-thick layer of twigs, leaves, and other organic material. The surface layer is brown gravelly loamy sand 9 inches thick. The underlying material is yellowish brown very gravelly sand to a depth of 60 inches or more.

Permeability of the Grenoble soil is very rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 24 to 42 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between depths of 2 to 3.5 feet from March through August. This soil is subject to frequent brief flooding from May through June.

The Gerrard soil is very deep and poorly drained. It formed in alluvium. Typically the surface is covered with a thin organic mat. The surface layer is dark gray and grayish brown loam 12 inches thick. The upper 12 inches of the underlying material are light brownish gray very gravelly loamy sand. The lower part is light gray very gravelly sand to a depth of 60 inches or more.

Permeability of the Gerrard soil is moderate in the surface layer and very rapid in the underlying material. Available water capacity is low. Effective rooting depth is 60 inches or more for plants that can tolerate a water table, but it is 5 to 18 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between the surface and a depth of 1.5 feet from March through August. This soil is subject to frequent brief flooding from May through June.

This unit is used mainly as rangeland and for wildlife habitat. A few areas are used for irrigated hay and pasture.

If this unit is used for hay and pasture, the main limitations are the wetness of the soils, flooding, and the gravelly surface layer of the Grenoble soil. Applications

of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of plants and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Grenoble soil is mainly basin wildrye, western wheatgrass, slender wheatgrass, and tufted hairgrass. As the range condition deteriorates, sedges and willows increase. As the range condition further deteriorates, bluegrass and annuals invade. The potential plant community produces about 3,700 pounds of air-dry vegetation per acre in normal years. Production ranges from 4,300 pounds in favorable years to 3,000 pounds in unfavorable years.

The potential plant community on the Gerrard soil is mainly Nebraska sedge, willows, and northern reedgrass. As the range condition deteriorates, willows increase. As the range condition further deteriorates, rushes, sedges, and annual forbs invade. The potential plant community produces about 5,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 6,000 pounds in favorable years to 3,500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the wetness of the soil. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to sustain grazing pressure.

This unit is well suited for stockwater ponds. Pits dug below the level of the water table can provide water for livestock. Because of the seepage potential of the soils, pit or other types of ponds will not hold water above the level of the water table for a long period of time. Because the water table is at a more shallow depth in the Gerrard soil, it is the most suitable soil for a pit.

This unit is poorly suited for mechanical range renovation and range seeding; the main limitations are the wetness of the Gerrard soil, and the gravelly surface layer and wind erosion hazard of the Grenoble soil. Adequate residue must be maintained on the surface of soil at all

times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If range seedings are planned, plant species should be carefully selected because of the wetness of the Gerrard soil. Use of equipment is limited to the periods when of the water table is the deepest.

The Grenoble soil is in capability subclass VI₁, irrigated and nonirrigated, and the Gerrard soil is in capability subclass VI_w, nonirrigated and irrigated. The Grenoble soil is in the Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site. The Gerrard soil is in the Wetland, 10- to 14-inch precipitation, High Plains Southeast range site.

168—Greyback very cobbly sandy loam, 1 to 6 percent slopes.

This very deep, somewhat excessively drained soil is on outwash alluvial fans. It formed in glacial outwash derived from various sources. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 8,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

Included in this unit are small areas of Hanson gravelly sandy loam and Silas gravelly loam. Also included are small areas of poorly drained soils in swales. Included areas make up about 30 percent of the total acreage.

Typically the surface is 30 percent covered with about 20 percent cobbles and 10 percent stones. The surface layer is grayish brown and brown very cobbly sandy loam 9 inches thick. The upper part of the subsoil is pale brown very cobbly sandy loam 7 inches thick. The next 14 inches are brown very cobbly coarse sandy loam. The next part is brown very gravelly loamy coarse sand 6 inches thick. The lower part is pale brown very gravelly coarse sandy loam to a depth of 60 inches or more.

Permeability of the Greyback soil is rapid. Available water capacity is very 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 slight.

This unit is used mainly as rangeland and for wildlife habitat. A few small areas are used for irrigated hay and pasture.

If this unit is used for irrigated hay and pasture, the main limitations are the cobbles and stones on the surface and the droughtiness of the soil. Frequent applications of irrigation water will be necessary because of the limited available water capacity of the soil. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer

is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Greyback soil is mainly bluebunch wheatgrass, Idaho fescue, western wheatgrass, and threetip sagebrush. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,700 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the droughtiness of the soil.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the very cobbly surface layer and the droughtiness of the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass VI_s, nonirrigated and irrigated. It is in the Coarse Upland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

169—Gypla loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained soil is on flood plains and in swales and sloughs. It formed in alluvium. The native vegetation consists mainly of grasses and grass-like plants. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period of 85 to 110 days.

Included in this unit are small areas of Alogia loam, Cattle loam, Kiltabar silty clay loam, and a moderately deep soil similar to the Gypla soil. Included areas make up about 30 percent of the total acreage.

Typically the surface layer is light yellowish brown loam 5 inches thick. The upper part of the subsoil is white silt loam 31 inches thick. The lower part is very pale brown gravelly silt loam to a depth of 60 inches or more. The subsoil contains a very high amount of gypsum and is moderately saline. In some areas, the surface layer is darker in color.

Permeability of the Gypla soil is moderate. Available water capacity is low. Effective rooting depth for most plants is 10 to 20 inches because the high contents of calcium carbonate, gypsum, and other salts restrict root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between 1.5 and 3.5 feet from April through July.

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

The potential plant community on this unit is mainly basin wildrye, alkali bluegrass, and alkali sacaton. As the range condition deteriorates, inland saltgrass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years. In some areas, greasewood, basin wildrye, and western wheatgrass are the main plant community. These areas have about one-half the annual vegetation production of this unit.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the alkalinity of the soil. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This soil is poorly suited for stockwater ponds. Although pits dug deeper than the level of the water table will create a source of water, the water may contain a high amount of undesirable salts. This soil is poorly suited for mechanical range renovation and range seeding; the main limitation is the salinity of the soil. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity of the soil.

This unit is in capability subclass VII_s, nonirrigated. It is in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site.

170—Gypla-Urban land complex, 0 to 1 percent slope.

This map unit is on flood plains and in swales and sloughs. The native vegetation consists mainly of grasses and grass-like plants. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air

temperature is 40 to 48 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Gypla loam and 40 percent Urban land. 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 Alogia loam and a moderately deep soil similar to the Gypla soil. Included areas make up about 10 percent of the total acreage.

The Gypla soil is very deep and somewhat poorly drained. It formed in alluvium. Typically the surface layer is light yellowish brown loam 5 inches thick. The upper part of the subsoil is white silt loam 31 inches thick. The lower part is very pale brown gravelly silt loam to a depth of 60 inches or more. The subsoil contains a very high amount of gypsum and is moderately saline.

Permeability of the Gypla soil is moderate. Available water capacity is low. Effective rooting depth for most plants is 10 to 20 inches because the high contents of calcium carbonate, gypsum, and other salts restrict root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between 1.5 and 3.5 feet from April through July.

Urban land is covered with buildings, streets, and parking lots. The original soil has been either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If the Gypla soil is used for urban development, the main limitations are the high corrosion potential of the soil to concrete and uncoated steel and the high water table. In addition, the growth of plants used for landscaping will be severely affected by the salinity of the Gypla soil. Use of this soil as a site for buildings with basements is not recommended due to the high water table. Septic tank absorption fields buried in the soil do not function properly due to the high water table. In addition, if several septic systems are installed in an area, the water added to the soil may raise the level of the water table.

The Gypla soil is in capability subclass VII, nonirrigated.

171—Hanson-Quander complex, 3 to 15 percent slopes.

This map unit is on outwash fan terraces. The native vegetation consists mainly of grasses, shrubs, and a few trees. Elevation is 7,800 to 8,500 feet. The annual precipitation is 15 to 19 inches, the annual air

temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 50 percent Hanson gravelly sandy loam and 30 percent Quander gravelly 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 Leavitt sandy clay loam. Also included are small areas of a soil similar to the Quander soil but which contains fewer cobbles. Included areas make up about 20 percent of the total acreage.

The Hanson soil is very deep and well drained. It formed in glacial outwash overlying glacial till. Typically the surface is 20 percent covered with gravel and 5 percent covered with cobbles. The surface layer is brown gravelly sandy loam 8 inches thick. The upper part of the subsoil is pinkish white and pink very cobbly loam 17 inches thick. The lower part is reddish yellow very cobbly clay loam to a depth of 60 inches or more. This Hanson soil is outside the characteristics of the Hanson series: the surface layer is slightly lighter in color and slightly thinner. This, however, does not affect the use and management of this soil for the purposes of this survey.

Permeability of the Hanson soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

The Quander soil is very deep and well drained. It formed in glacial drift. Typically the surface is 45 percent covered with 40 percent gravel and 5 percent cobbles. The surface layer is grayish brown and brown gravelly loam 12 inches thick. The subsoil is light yellowish brown and reddish yellow very cobbly clay loam 24 inches thick. The substratum is yellow very cobbly sandy clay loam to a depth of 60 inches or more.

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

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

The potential plant community on this unit is mainly bluebunch wheatgrass, Griffith wheatgrass, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, curlycup gumweed and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges

from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the content of rock fragments in the soils. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the gravel and cobbles on the surface of the soil.

This unit is in capability subclass VIe, nonirrigated. It is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

172—Hapjack-Rogert-Amesmont complex, 3 to 25 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 30 percent Hapjack gravelly sandy loam, 5 to 25 percent slopes; 30 percent Rogert gravelly sandy loam, 5 to 25 percent slopes; and 20 percent Amesmont fine sandy loam, 3 to 10 percent slopes. The Hapjack and Rogert soils are on the crests of hills, upper areas of the back slopes of hills, and upper portions of mountain slopes. The Amesmont soil is on the foot slopes and lower back slopes of hills and mountain slopes, and in swales. 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 Vensora loam and a soil similar to the Amesmont soil, but which is deeper than 40 inches to bedrock. Also included are very shallow soils and Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Hapjack soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 40 percent covered with fine granitic gravel. The surface layer is brown gravelly sandy loam 3 inches thick. The subsoil is brown gravelly sandy clay loam 7 inches thick. The substratum is brown extremely gravelly sandy loam 9 inches thick. Hard granite is at a depth of 19 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Hapjack soil is moderate. 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 moderate. Winter winds remove the snow from the surface of this soil.

The Rogert soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 40 percent covered with small granitic gravel. The surface layer is brown gravelly sandy loam 8 inches thick. The underlying material is brown very gravelly sandy loam 8 inches thick. Hard granite is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Rogert soil is moderately rapid. 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 moderate. Winter winds remove the snow from the surface of this soil.

The Amesmont soil is moderately deep and well drained. It formed in residuum and colluvium derived from granite. Typically the surface is 20 percent covered with fine granitic gravel. The surface layer is brown fine sandy loam 5 inches thick. The upper 9 inches of the subsoil are brown sandy clay loam. The lower 6 inches are brown gravelly sandy clay loam. The substratum is strong brown very gravelly sandy clay loam 13 inches thick. Highly fractured granite is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Amesmont soil is moderate. Available water capacity is very 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. Winter winds deposit additional snow on this soil.

This unit is used as rangeland, for wildlife habitat, and for recreation.

The potential plant community on this unit is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the slope. The Rogert and Hapjack soils are poorly suited for mechanical range renovation and range seeding; the main limitations are the rock fragments on the surface and the droughtiness of the soils.

The Amesmont soil is moderately suited for range seeding. The main limitation is the hazard of water erosion. Mechanical range renovation may not be practical due to the amount of sagebrush growing on the soil. Brush control may be needed if the amount of brush growing on the soil is more than would be present in the potential plant community.

The Hapjack and Rogert soils are in capability subclass VIIe, nonirrigated. The Amesmont soil is in capability subclass VIe, nonirrigated. This unit is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

173—Ipson-Evanston complex, 6 to 30 percent slopes.

This map unit is on dissected fan terraces and alluvial fans. The native vegetation consists mainly of grasses and forbs. Elevation is 6,500 to 7,200 feet. The annual precipitation is 15 to 17 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Ipson gravelly sandy loam and 35 percent Evanston fine sandy loam. Ipson soils are on the convex slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blazon loam, Chaperon loam, and Forelle loam. Included areas make up about 15 percent of the total acreage.

The Ipson soil is very deep and well drained. It formed in alluvium. Typically the surface layer is grayish brown and brown gravelly sandy loam 8 inches thick. The subsoil is brown very gravelly sandy clay loam 6 inches thick. The substratum is pale brown and very pale brown very gravelly coarse sandy loam to a depth of 60 inches or more. This soil is outside the characteristics of the Ipson series because the C horizon does not contain calcium carbonate. This difference, however, does not significantly affect the use or management of the soil.

Permeability of the Ipson soil is moderate. 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 slight.

The Evanston soil is very deep and well drained. It formed in alluvium. Typically the surface layer is dark grayish brown fine sandy loam 3 inches thick. The upper part of the subsoil is dark grayish brown sandy clay loam

14 inches thick. The next part is light brownish gray clay loam 33 inches thick. The lower part is pale olive clay loam to a depth of 60 inches or more.

Permeability of the Evanston 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly needleandthread, western wheatgrass, and blue grama. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed and annual grasses invade. The potential plant community produces about 1,400 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,900 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. This unit is well suited to the production of vegetation suitable for livestock grazing.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The unit is in capability subclass VIe, nonirrigated. It is in the Loamy, 15- to 17-inch precipitation, Southern Plains range site.

174—Joemre fine sandy loam, 3 to 6 percent slopes.

This very deep, well drained soil is on alluvial fans and terraces. It formed in alluvium derived dominantly from redbed sedimentary rock. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Alcova sandy loam, Almy loam, Fiveoh sandy loam, and Wycolo sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is yellowish red fine sandy loam 2 inches thick. The upper part of the subsoil is yellowish red fine sandy loam and loam 11 inches thick. The lower part is yellowish red fine sandy loam to a depth of 60 inches or more.

Permeability of the Joemre soil is moderately rapid. 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Joemre soil is mainly needleandthread, Indian ricegrass, thickspike wheatgrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

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

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

175—Joemre fine sandy loam, 6 to 15 percent slopes.

This very deep, well drained soil is on alluvial fans. It formed in alluvium derived dominantly from redbed sedimentary rock. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Alcova sandy loam, Almy loam, and Wycolo sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is brown fine sandy loam 2 inches thick. The upper part of the subsoil is reddish brown and yellowish red fine sandy loam 14 inches thick.

The lower part is yellowish red fine sandy loam to a depth of 60 inches or more.

Permeability of the Joemre soil is moderately rapid. 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 severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Joemre soil is needleandthread, Indian ricegrass, thickspike wheatgrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

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

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

176—Kezar-Carbol-Rock outcrop complex, 5 to 25 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,000 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 35 percent Kezar sandy loam, 30 percent

Carbol sandy loam, and 15 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 Amesmont fine sandy loam, Hapjack gravelly sandy loam, Rogert gravelly sandy loam, and Silas loam. Included areas make up about 20 percent of the total acreage.

The Kezar soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface layer is brown and dark yellowish brown sandy loam 10 inches thick. The upper part of the subsoil is brown sandy clay loam 10 inches thick. The lower part is light olive brown very cobbly sandy clay loam 11 inches thick. Hard granite is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Kezar 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 severe.

The Carbol soil is shallow and well drained. It formed in residuum and colluvium derived from granite. Typically the surface is 25 percent covered with gravel. The surface layer is brown sandy loam 4 inches thick. The subsoil is dark yellowish brown cobbly sandy clay loam 9 inches thick. The substratum is yellowish brown extremely cobbly sandy clay loam 6 inches thick. Hard granite is at a depth of 19 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Carbol soil is moderate. 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 severe.

Rock outcrop consists of exposures of hard anorthositic granite.

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

The potential plant community on the Kezar soil is mainly bluebunch wheatgrass, prairie junegrass, Griffith wheatgrass, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Carbol soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community

produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. The Kezar soil is well suited to the the production of vegetation suitable for livestock grazing. Production on the Carbol soil is limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Kezar soil is in capability subclass VIe, nonirrigated. The Carbol soil is in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Kezar soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Carbol soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

177—Kildor-Rock outcrop association, 5 to 50 percent slopes.

This map unit is on mountainsides and mountain toe slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 8,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 40 percent Kildor gravelly loam and 30 percent Rock outcrop. The Kildor soil occurs on back slopes and toe slopes of mountains. The Rock outcrop occurs on shoulder slopes of mountains and escarpments.

Included in this unit are small areas of Miracle fine sandy loam and a shallow clayey soil. Also included are small areas of a very deep clayey soil on toe slopes. Included areas make up about 30 percent of the total acreage.

The Kildor soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from shale. Typically the surface is 20 percent covered with gravel and 10 percent covered with cobbles. The surface layer is dark grayish brown gravelly loam 10 inches thick. The upper part of the subsoil is yellowish brown and light olive brown clay loam 12 inches thick. The lower part is light gray clay 16 inches thick. Weakly consolidated shale is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Kildor soil is slow. 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 slight.

Rock outcrop consists of exposures of weakly consolidated multicolored shale.

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

The potential plant community on the Kildor soil is mainly bluebunch wheatgrass, prairie junegrass, Griffith wheatgrass, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, big sagebrush, and rabbitbrush increase. As the range condition further deteriorates, broom snakeweed, cactus, cheatgrass, and annuals invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. The Kildor soil is well suited to the production of vegetation suitable for livestock grazing. The amount of Rock outcrop in this unit influences the amount of the forage available for livestock grazing.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Kildor soil is in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Kildor soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

178—Kiltabar-Tismid complex, 0 to 3 percent slopes.

This map unit is on stream terraces, in drainageways, and in areas adjacent to playas and intermittent lakes. The native vegetation consists mainly of grasses and shrubs. Hummocky microrelief is common in many areas. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

This unit is 45 percent Kiltabar silty clay loam and 35 percent Tismid 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 Elkol silty clay loam, Forelle loam, Gerdrum Family loam, and Rock River sandy loam. Also included adjacent to creeks and rivers are small areas of Glendive sandy loam and Redrob loam. Included areas make up about 20 percent of the total acreage.

The Kiltabar soil is very deep and somewhat poorly drained. It formed in alluvium. Typically the surface layer is strongly saline yellowish brown silty clay loam 1 inch thick. The upper 15 inches of the subsoil are strongly saline dark yellowish brown silty clay loam. The next 24 inches are strongly saline yellowish brown clay loam. The lower part to a depth of 60 inches or more is moderately saline yellowish brown clay loam. In some areas, the surface layer is slightly darker in color.

Permeability of the Kiltabar soil is moderately slow. 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. A seasonal high water table is at a depth of 2 to 4 feet from March through September. This soil is subject to a rare hazard of flooding.

The Tismid soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown sandy loam 4 inches thick. The upper part of the subsoil is pale brown sandy clay loam 3 inches thick. The next 13 inches are very strongly alkaline light yellowish brown clay loam. The lower part is moderately saline light yellowish brown loam and sandy clay loam to a depth of 60 inches or more.

Permeability of the Tismid soil is moderately slow. 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.

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

The potential plant community on this unit is mainly alkali sacaton, basin wildrye, black greasewood, inland saltgrass, and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the salinity and alkalinity of the soils. Loss of

the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing.

This unit is well suited for stockwater ponds. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the salinity and alkalinity of the soils. The low annual precipitation should also be of concern when planning range seedings. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity and alkalinity of the soil. Because the seedings will be only slightly successful, they should be conducted only if there are no other alternatives to forage improvement.

The Kiltabar soil is in capability subclass VII_s, nonirrigated. The Tismid soil is in capability subclass VI_s, nonirrigated. This unit is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site.

179—Lakehelen-Redfeather-Amesmont complex, 5 to 20 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of trees, grasses, and shrubs. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 40 percent Lakehelen fine sandy loam, 30 percent Redfeather gravelly sandy loam, and 20 percent Amesmont 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 Hapjack gravelly sandy loam, Rogert gravelly sandy loam, and Vensora loam. Included areas make up about 10 percent of the total acreage.

The Lakehelen soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is covered with a 2-inch-thick mat of needles, twigs, and bark in various stages of decomposition. The surface layer is light yellowish brown fine sandy loam 17 inches thick. The subsoil is strong brown very gravelly sandy clay loam 9 inches thick. The substratum is reddish brown extremely gravelly sandy loam 12 inches thick. Hard granite is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Lakehelen 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 severe.

The Redfeather soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is covered with a 2-inch-thick mat of needles, twigs, and bark in various stages of decomposition. The surface layer is light yellowish brown gravelly sandy loam 14 inches thick. The subsoil is brown very gravelly sandy clay loam 5 inches thick. Hard granite is at a depth of 19 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Redfeather soil is moderate. 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 moderate.

The Amesmont soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface layer is brown fine sandy loam 5 inches thick. The subsoil is strong brown gravelly sandy clay loam 8 inches thick. The substratum is strong brown very gravelly sandy loam 8 inches thick. Fractured granite is at a depth of 21 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Amesmont soil is moderate. Available water capacity is very 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.

This unit is used mainly for recreation and for wildlife habitat. Some areas are also used as rangeland or for timber production.

The present vegetation on the Lakehelen soil is lodgepole pine or Douglas-fir with an understory of elk sedge, king spike fescue, bluegrasses, kinnikinnick, creeping juniper, aspen, heartleaf arnica, prairie thermopsis, penstemon, geranium, rose pussytoes, Oregon grape, western yarrow, Idaho fescue, Columbia needlegrass, cinquefoil, stonecrop, and larkspur.

The Lakehelen soil is moderately well suited to the production of lodgepole pine and Douglas-fir for timber harvesting. The woodland site index ranges from 35 to 45 for lodgepole pine and from 25 to 30 for Douglas-fir. Production of lodgepole pine is 25 to 35 cubic feet per acre per year. Production of Douglas-fir is 20 to 30 cubic feet per acre per year. Timber production is limited because of steepness of the slope and the slow growth of the trees.

The present vegetation on the Redfeather soil is lodgepole pine with an understory of elk sedge, kinnikinnick, bluegrasses, king spike fescue, rose pussytoes, low sedge, creeping juniper, antelope bitterbrush, Idaho fescue, western yarrow, cinquefoil, Oregon grape, and violet.

The Redfeather soil is moderately suited to the production of lodgepole pine for timber harvesting.

The site index for lodgepole pine ranges from 30 to 40. Production is 20 to 30 cubic feet per acre per year. Timber production is limited by the slow growth of the trees and the steepness of slope.

The potential plant community on the Amesmont soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation suitable for livestock grazing on the Lakehelen and Redfeather soils is severely limited by the dense tree cover, which limits the growth of the understory vegetation. Production on the Amesmont soil is moderately limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Lakehelen and Amesmont soils are in capability subclass VIe, nonirrigated; the Redfeather soil is in capability subclass VIIe, nonirrigated. The Lakehelen and Redfeather soils are in the Douglas-fir woodland site. The Amesmont soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

180—Leavitt gravelly fine sandy loam, 1 to 8 percent slopes.

This very deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from granite. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 8,900 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free season is less than 60 days.

Included in this unit are small areas of Granile gravelly loam and Teeler very gravelly sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface is 10 percent covered with gravel. The surface layer is brown gravelly fine sandy loam 6 inches thick. The upper part of the subsoil is brown gravelly loam 9 inches thick. The next part is light yellowish brown very gravelly clay loam 7 inches thick.

The lower part is very pale brown very gravelly coarse sandy loam to a depth of 60 inches or more. This soil is outside the characteristics of the Leavitt series because it has slightly more gravel in the middle and lower subsoil layers. This difference, however, does not significantly affect the use or management of this soil for the purposes of this survey.

Permeability of the Leavitt 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.

This unit is used as rangeland and for wildlife habitat. It is also used for recreation.

The potential plant community on the Leavitt soil is mainly bluebunch wheatgrass, Idaho fescue, prairie junegrass, and Griffith wheatgrass. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, cheatgrass and annuals invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. This unit is well suited to the production of vegetation suitable for livestock grazing.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazard of wind erosion and the gravelly surface layer. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass VIi, nonirrigated. It is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

181—Leavitt-Granile complex, 3 to 45 percent slopes.

This map unit is on fan terrace escarpments. The native vegetation consists mainly of grasses. Elevation is 7,600 to 8,200 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 50 percent Leavitt gravelly loam, 3 to 45 percent slopes and 35 percent Granile gravelly sandy loam, 6 to 45 percent slopes. The components of this unit

are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Quander gravelly loam and Teeler very gravelly sandy loam. Included areas make up about 15 percent of the total acreage.

The Leavitt soil is very deep and well drained. It formed in alluvium derived dominantly from granite. Typically the surface layer is brown gravelly loam 4 inches thick. The upper part of the subsoil is brown and light yellowish brown gravelly clay loam 13 inches thick. The next part is reddish yellow very gravelly clay loam 9 inches thick. The lower part is light brown clay to a depth of 60 inches or more. This soil is outside the characteristics of the Leavitt series because it has slightly more gravel in the upper and middle subsoil layers and slightly more clay in the lower subsoil layer. This difference, however, does not significantly affect the use or management of this soil for the purposes of this survey.

Permeability of the Leavitt soil is moderate in the upper part of the subsoil and slow in the lower part of the subsoil. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Granile soil is very deep and well drained. It formed in alluvium derived dominantly from granite. Typically the surface is 15 percent covered with gravel and a few cobbles. The surface layer is dark grayish brown gravelly sandy loam 4 inches thick. The subsoil is brown very gravelly sandy clay loam 15 inches thick. The substratum is brown very gravelly sandy clay loam to a depth of 60 inches or more.

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

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

The potential plant community on the Leavitt soil is mainly bluebunch wheatgrass, Idaho fescue, prairie junegrass, and Griffith wheatgrass. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, cheatgrass and annuals invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Granile soil is mainly bluebunch wheatgrass, Griffith wheatgrass, threetip sagebrush, black sagebrush, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge

increase. As the range condition further deteriorates, curlycup gumweed, cheatgrass, and broom snakeweed invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. The Leavitt soil is well suited to the production of vegetation suitable for livestock grazing. Production on the Granile soil is moderately limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

This unit is in capability subclass VIIe, nonirrigated. The Leavitt soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site; the Granile soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

182—Leavitt-Hanson complex, 3 to 30 percent slopes.

This map unit is on fan terraces. The native vegetation consists mainly of grasses. Elevation is 7,800 to 8,200 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 60 percent Leavitt loam, 3 to 30 percent slopes and 20 percent Hanson gravelly sandy loam, 3 to 15 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ansel gravelly sandy loam, Granile gravelly sandy loam, and Quander gravelly loam. Included areas make up about 20 percent of the total acreage.

The Leavitt soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown loam 10 inches thick. The upper part of the subsoil is light yellowish brown clay loam 16 inches thick. The lower part is pale brown loam and clay loam 25 inches thick. The substratum is very pale loam to a depth of 60 inches or more.

Permeability of the Leavitt 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 Hanson soil is very deep and well drained. It formed in glacial outwash. Typically the surface is 40 percent covered with gravel and 5 percent covered with cobbles. The surface layer is dark grayish brown gravelly sandy loam 8 inches thick. The upper part of the subsoil is light gray very cobbly loam 10 inches thick. The lower part is white very cobbly loam to a depth of 60 inches or more. This soil is outside the characteristics of the Hanson series because the surface layer is slightly lighter colored and slightly thinner. This difference, however, does not significantly affect the use and management of this soil for the purposes of this survey.

Permeability of the Hanson soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

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

The potential plant community on the Leavitt soil is mainly bluebunch wheatgrass, Idaho fescue, Griffith wheatgrass, and prairie junegrass. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, cheatgrass and annuals invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Hanson soil is mainly bluebunch wheatgrass, threetip sagebrush, Griffith wheatgrass, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, curlycup gumweed and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. The Leavitt soil is well suited to the production of vegetation suitable for livestock grazing. Production on the Hanson soil is limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds due to the potential for seepage losses and the steepness of

slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the steepness of slope and the gravelly surface layer of the Hanson soil. In addition, mechanical range renovation may not be practical in many areas due to the amount of sagebrush growing on the soil. Brush control may be needed in areas where there is more brush than would be present in the potential plant community.

This unit is in capability subclass VIe, nonirrigated. The Leavitt soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Hanson soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

183—Leavitt-Quander complex, 15 to 45 percent slopes.

This map unit is on escarpments of outwash fan terraces. The native vegetation consists mainly of grasses. Elevation is 7,600 to 8,200 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 50 percent Leavitt loam and 30 percent Quander gravelly 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 Hanson gravelly sandy loam and a soil similar to the Quander soil, but with a very cobbly sandy loam subsoil. Also included are small areas of Lymanson loam. Included areas make up about 20 percent of the total acreage.

The Leavitt soil is very deep and well drained. It formed in local alluvium. Typically the surface layer is brown loam 5 inches thick. The upper part of the subsoil is brown clay loam 15 inches thick. The lower part is pale brown and yellowish brown clay loam to a depth of 60 inches or more.

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

The Quander soil is very deep and well drained. It formed in glacial drift. Typically the surface is 25 percent covered with gravel and 20 percent covered with cobbles. The surface layer is dark grayish brown gravelly loam 10 inches thick. The upper part of the subsoil is reddish yellow and brownish yellow very cobbly clay loam 20 inches thick. The lower part is brownish yellow very gravelly clay loam 15 inches thick. The substratum is brownish yellow very cobbly clay loam to a depth of 60 inches or more.

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

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

The potential plant community on the Leavitt soil is mainly bluebunch wheatgrass, Idaho fescue, Griffith wheatgrass, and prairie junegrass. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, cheatgrass and annuals invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Quander soil is mainly bluebunch wheatgrass, Griffith wheatgrass, threetip sagebrush, black sagebrush, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, curlycup gumweed, cheatgrass, and broom snakeweed invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. The Leavitt soil is well suited to the production of vegetation suitable for livestock grazing. Production on the Quander soil is limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

This unit is in capability subclass VIIe, nonirrigated. The Leavitt soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Quander soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

184—Luhon loam, 1 to 5 percent slopes.

This very deep, well drained soil is on foot slopes and toe slopes of hills and on terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature

is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Cushool sandy loam, Forelle loam, Poposhia loam, and Stunner sandy loam. Also included are a soil similar to the Luhon soil that supports a very sparse amount of vegetation because of high amount of calcium carbonate close to the soil surface; a coarser textured soil that occurs east of the lower reaches of Spring Creek; and soils that have weakly consolidated bedrock within a depth of 20 to 40 inches. Included areas make up about 20 percent of the total acreage.

Typically the upper part of the surface layer is pale brown loam 2 inches thick. The lower part is light yellowish brown loam 6 inches thick. The subsoil is pale yellow and light yellowish brown silt loam to a depth of 60 inches or more. The subsoil contains a high amount of calcium carbonate.

Permeability of the Luhon soil is moderate. Available water capacity is high. Effective rooting depth is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Luhon soil is mainly bluebunch wheatgrass, mutton bluegrass, needleandthread, black sagebrush, and western wheatgrass. As the range condition deteriorates, shorter grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the high amount of calcium carbonate in the subsoil and by the low annual precipitation.

This soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. It is well suited for mechanical range renovation and range seeding. The low annual precipitation, however, should be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. It is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

185—Luvar-Stylite-Diamonkit complex, 1 to 8 percent slopes.

This map unit is on hillslopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,500 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Luvar loam, 25 percent Stylite fine sandy loam, and 15 percent Diamonkit 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 Forelle loam, Luhon loam, and a shallow soil similar to the Diamonkit soil. Also included are small areas of Browtine very gravelly fine sandy loam and a sandy loam soil with a gypsiferous subsoil. Included areas make up about 20 percent of the total acreage.

The Luvar soil is very deep and well drained. It formed in alluvium. Typically the surface is 10 percent covered with gravel. The surface layer is dark brown loam 2 inches thick. The upper part of the subsoil is yellowish brown loam 10 inches thick. The next part is very pale brown clay loam 20 inches thick. The lower part to a depth of 60 inches or more is light yellowish brown loam and clay loam with common masses of gypsum.

Permeability of the Luvar soil is moderate. Available water capacity is high. Effective rooting depth is 20 to 30 inches because the high content of gypsum in the lower part of the subsoil restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

The Stylite soil is very deep and well drained. It formed in alluvium derived dominantly from gypsiferous sedimentary rock. Typically the surface layer is yellowish brown fine sandy loam 2 inches thick. The upper part of the subsoil is brown and yellowish brown loam 12 inches thick. The next part is very pale brown clay loam 16 inches thick. The lower part to a depth of 60 inches or more is pale brown loam and light yellowish clay loam with many soft masses of gypsum.

Permeability of the Stylite soil is moderate. Available water capacity is high. Effective rooting depth is 20 to 30 inches because the high content of gypsum in the lower part of the subsoil restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Diamonkit soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from gypsiferous sandstone and shale. Typically the surface layer is pale brown sandy loam 1 inch thick. The upper part of the subsoil is yellowish brown loam 21 inches thick. The lower 13 inches are pale yellow and pale brown clay loam with many soft masses of gypsum. Weakly consolidated shale bedrock is at a depth of 35 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Diamonkit soil is moderate. Available water capacity is moderate. Effective rooting depth is 15 to 25 inches because the high content of gypsum in the lower subsoil restrict root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used mainly as rangeland. It is also used for wildlife habitat.

The potential plant community on the Luvar and Stylite soils is mainly western wheatgrass, bluebunch wheatgrass, big sagebrush, and needleandthread. As the range condition deteriorates, blue grama and big sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Diamonkit soil is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, black sagebrush, and mutton bluegrass. As the range condition deteriorates, prairie junegrass, Sandberg bluegrass, and big sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Luvar and Stylite soils is moderately limited by the low annual precipitation. Production on the Diamonkit soil is limited by the low annual precipitation and by the shallow effective rooting depth.

This unit is poorly suited for stockwater ponds. The main limitations are the potential for seepage losses and the piping. The depth to bedrock in the Diamonkit soil is also a limitation.

This unit is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass IVe, nonirrigated. The Luvar and Stylite soils are in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Diamonkit soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

186—Lymanson loam-Lymanson cobbly loam complex, 6 to 20 percent slopes.

This map unit is on hills. The native vegetation consists mainly of grasses, forbs, and shrubs. Elevation is 7,800 to 9,000 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is 50 percent Lymanson loam and 30 percent Lymanson cobbly 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 Buffork sandy loam and Leavitt sandy loam. Also included are small areas of soils similar to the Lymanson loam, but which are not calcareous or have a redder color. Included areas make up about 20 percent of the total acreage.

The Lymanson loam soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from sedimentary rock. Typically the surface is about 25 percent covered with gravel and cobbles. The surface layer is brown loam 7 inches thick. The upper part of the subsoil is light yellowish brown clay loam 9 inches thick. The lower part is light brownish gray clay loam 19 inches thick. Weakly consolidated shale is at a depth of 35 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of Lymanson loam soil is moderate. Available water capacity is moderate. The 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.

Lymanson cobbly loam soil is moderately deep and well drained. It formed in alluvium overlying residuum derived from sedimentary rock. Typically the surface is 50

percent covered with cobbles, gravel, and a few stones. The surface layer is brown cobbly loam 7 inches thick. The upper 10 inches of the subsoil are light yellowish brown clay loam. The lower part is light yellowish brown loam 14 inches thick. Weakly consolidated sandstone is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of Lymanson cobbly loam 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 slight.

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

The potential plant community on the Lymanson loam soil is mainly bluebunch wheatgrass, Idaho fescue, prairie junegrass, and Griffith wheatgrass. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, cheatgrass and annuals invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Lymanson cobbly loam soil is mainly bluebunch wheatgrass, Idaho fescue, western wheatgrass, prairie junegrass, and threetip sagebrush. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,700 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. This unit is well suited to the production of vegetation suitable for livestock grazing.

This unit is poorly suited for stockwater ponds due to the steepness of slope and the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the cobbly surface layer in some areas and the hazard of water erosion. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass VIe, nonirrigated. The Lymanson loam soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range

site. The Lymanson cobbly loam soil is in the Coarse Upland, 15- to 19-inch precipitation, Foothills and Mountains, Southeast range site.

187—Manada sandy loam, 0 to 6 percent slopes.

This very deep, somewhat poorly drained soil is on fan terraces. It formed in alluvium. The vegetation is mainly irrigated native grass, hay, and pasture. Elevation is 7,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Browline very gravelly sandy loam, Folavar gravelly sandy loam, Hilltoppe very gravelly sandy loam, and McFadden gravelly fine sandy loam. Included areas make up about 25 percent of the total acreage.

Typically the surface is 10 percent covered with medium and fine gravel. The surface layer is dark grayish brown sandy loam 2 inches thick. The upper part of the subsoil is brown loam 7 inches thick. The next part is very pale brown and light gray gravelly sandy loam 18 inches thick. The next part to a depth of 35 inches are white gravelly loam. It contains a high amount of calcium carbonate. The lower part is very pale brown gravelly sandy loam to a depth of 60 inches or more.

Permeability of the Manada soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants; for other it is 24 to 36 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe. From April through July a seasonal high water table is at a depth of 2 and 3 feet. The water table is below a depth of 3 feet the remainder of the year.

This unit is used mainly for irrigated hay and pasture.

If this unit is used for hay and pasture, the main limitation is the high content of calcium carbonate in the lower subsoil layers because this affects rooting depth and nutrient availability. In addition, applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in

compaction of the surface layer, poor tilth, and excessive runoff.

This unit is in capability subclass IVw, irrigated and nonirrigated.

188—McFadden gravelly fine sandy loam, 1 to 6 percent slopes.

This very deep, well drained soil is on fan terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 38 to 40 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Browline very gravelly fine sandy loam, Hilltoppe very gravelly sandy loam, Luhon loam, Lupinto gravelly fine sandy loam, and Stunner sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface is about 15 percent covered with gravel. The surface layer is brown gravelly fine sandy loam 5 inches thick. The upper part of the subsoil is pale brown and very pale brown gravelly fine sandy loam 13 inches thick. The substratum is light gray loam to a depth of 60 inches or more. The subsoil and substratum contain a high amount of calcium carbonate.

Permeability of the McFadden soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants; for others it is only 10 to 30 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

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

The potential plant community on the McFadden soil is mainly bluebunch wheatgrass, Indian ricegrass, threadleaf sedge, mutton bluegrass, and needleandthread. As the range condition deteriorates, shorter species of grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the high content of calcium carbonate in the subsoil and by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazard of wind erosion and the gravelly surface layer. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this soil near the Platte County line near Highway 34 are in a similar range site in the 12- to 14-inch precipitation Southern Plains zone.

189—Miracle-Cheadle association, 5 to 20 percent slopes.

This map unit is on cuestas. The native vegetation consists mainly of grasses, shrubs, and a few trees. Elevation is 7,600 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 45 percent Miracle fine sandy loam, 5 to 10 percent slopes and 30 percent Cheadle fine sandy loam, 8 to 20 percent slopes. The Miracle soil is on slightly convex slopes. The Cheadle soil is on more convex slopes, often adjacent to Rock outcrops.

Included in this unit are small areas of Passcreek fine sandy loam, Cheadle cobbly very fine sandy loam, sandstone Rock outcrop, and a very deep soil similar to the Miracle soil. Also included are small areas of limestone Rock outcrop and sandy soils. Included areas make up about 25 percent of the total acreage.

The Miracle soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from sandstone and shale. Typically the surface layer is brown fine sandy loam 4 inches thick. The upper 8 inches of the subsoil are brown sandy clay loam. The next 16 inches are red and reddish brown sandy clay loam. The lower part is reddish brown sandy loam 5 inches thick. Hard sandstone is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Miracle 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 severe.

The Cheadle soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from interbedded sandstone and limestone. Typically the surface is 35 percent covered with gravel and cobbles.

The surface layer is brown fine sandy loam 4 inches thick. The subsoil is brown channery fine sandy loam 5 inches thick. The substratum is yellowish red very channery fine sandy loam 7 inches thick. Hard sandstone is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches. This soil is outside the characteristics of the Cheadle series because it does not have a horizon which contains an accumulation of calcium carbonate. This difference, however, does not significantly affect the use or management of this soil.

Permeability of the Cheadle soil is moderately rapid. 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 severe. Winter winds remove the snow from the surface of this soil.

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

The potential plant community on the Miracle soil is mainly bluebunch wheatgrass, prairie junegrass, Griffith wheatgrass, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Cheadle soil is mainly bluebunch wheatgrass, threetip sagebrush, black sagebrush, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. The Miracle soil is well suited the production of vegetation suitable for livestock grazing. Production on the Cheadle soil is limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the steepness of slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the cobbles on the surface of the Cheadle soil and the hazard of water erosion.

The Miracle soil is in capability subclass VIe, nonirrigated. The Cheadle soil is in capability subclass VIIe, nonirrigated. The Miracle soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Cheadle soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

190—Moyerson-Kemmerer complex, 3 to 20 percent slopes.

This map unit is on escarpments. The native vegetation consists mainly of grasses, forbs, and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Moyerson silty clay loam and 30 percent Kemmerer 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 Blazon clay loam, Chaperton clay loam, Diamondville fine sandy loam, and Pinelli clay loam. Also included are small areas of Rock outcrop and a soil similar to the Kemmerer soil, but with a more pronounced subsoil. Included areas make up about 30 percent of the total acreage.

The Moyerson soil is shallow and well drained. It formed in residuum and alluvium derived dominantly from shale. Typically the surface is about 5 percent covered with slate fragments and 10 percent covered with igneous gravel and cobbles. The surface layer is light brownish gray silty clay loam 4 inches thick. The underlying material is light brownish gray and light gray silty clay about 13 inches thick. Weakly consolidated shale is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Moyerson soil is 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.

The Kemmerer soil is moderately deep and well drained. It formed in residuum and alluvium derived dominantly from shale. Typically the surface layer is light brownish gray clay loam 2 inches thick. The upper part of the subsoil is grayish brown clay loam 13 inches thick. The lower part is gray silty clay loam and olive gray silty clay 19 inches thick. Weakly consolidated shale is at a depth of 34 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Kemmerer soil is slow. 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 mainly as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, bottlebrush squirreltail, birdfoot sagebrush, gardner saltbush, and Indian ricegrass. As the range condition deteriorates, birdfoot sagebrush increases. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness and alkalinity of the soils, and by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the hazard of water erosion and alkalinity of the soils.

The Moyerson soil is in capability subclass VIIe, nonirrigated. The Kemmerer soil is in capability subclass VIe, nonirrigated. This unit is in the Impervious Clay, 10- to 14-inch precipitation, High Plains Southeast range site.

191—Nathale-Passcreek, cobbly subsoil-Rock outcrop complex, 10 to 60 percent slopes.

This map unit is on mountain slopes and canyon sides. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 35 percent Nathale gravelly fine sandy loam; 35 percent Passcreek very fine sandy loam, cobbly subsoil; and 10 percent Rock outcrop. The Nathale soil occurs throughout the unit but is predominantly on south-facing canyon sides. The Passcreek soil is on north-facing canyon sides. The Rock outcrop is interspersed throughout the unit and occurs as ledges.

Included in this unit are small areas of Cheadle fine sandy loam, Miracle fine sandy loam, Rimton very fine sandy loam, and Cheadle cobbly very fine sandy loam. Also included is a deep soil similar to the Miracle soil. Included areas make up about 20 percent of the total acreage.

The Nathale soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from interbedded limestone and sandstone. Typically the

surface is 60 percent covered with gravel and cobbles. The surface layer is brown gravelly fine sandy loam 4 inches thick. The upper 7 inches of the subsoil are brown very cobbly very fine sandy loam. The lower part is pale brown very cobbly very fine sandy loam and very cobbly fine sandy loam 13 inches thick. Hard limestone is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Nathale soil is moderately rapid. Available water capacity is very low. 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 Passcreek soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from limestone. Typically the surface layer is dark brown very fine sandy loam 7 inches thick. The upper part of the subsoil is dark yellowish brown sandy clay loam 9 inches thick. The lower part is brown very cobbly fine sandy loam 15 inches thick. Hard limestone is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Passcreek soil is moderate. Available water capacity is very low. 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 severe.

Rock outcrop consists of exposures of interbedded limestone and sandstone.

This unit is used mainly for wildlife habitat. A few areas are also used as rangeland.

The potential plant community on the Nathale soil is mainly bluebunch wheatgrass, Idaho fescue, prairie junegrass, and western wheatgrass. As the range condition deteriorates, blue grama and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,300 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,700 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Passcreek soil is mainly bluebunch wheatgrass, prairie junegrass, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Nathale soil is limited by the droughtiness of the soil; the Passcreek soil is well suited to production.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Nathale and Passcreek soils are in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIII. The Nathale soil is in the Coarse Upland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Passcreek soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

192—Pahlow gravelly sandy loam, 0 to 3 percent slopes.

This very deep, well drained soil is on terraces with a mound-intermound pattern of microrelief. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Folavar very gravelly sandy loam; Borollic Camborthids soils; and a soil similar to the Pahlow soil, but with a 10- to 20-inch-thick loamy layer over gravelly sand. In areas near Boswell, wet areas and soils with stones and cobbles are included in the profile. Included areas make up about 15 percent of the total acreage.

Typically the surface is 25 percent covered with gravel. The surface layer is brown gravelly sandy loam 3 inches thick. The upper part of the subsoil is dark yellowish brown and brown very gravelly sandy loam 12 inches thick. The lower part is pale brown very gravelly loamy sand and extremely gravelly loamy sand to a depth of 60 inches or more.

Permeability of the Pahlow soil is moderately rapid in the upper part of the subsoil and rapid in the lower part. Available water capacity is very 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 moderate.

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

If this unit is used for hay and pasture, the main limitations are the hummocky terrain and the droughtiness of the soil. Frequent applications of irrigation water will be necessary because of the limited available water capacity

of the soil. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Pahlow soil is mainly needleandthread, Indian ricegrass, threadleaf sedge, silver sagebrush, and thickspike wheatgrass. As the range condition deteriorates, big sagebrush, rabbitbrush, cactus, and thinleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazard of wind erosion and the gravelly surface layer. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass VI_s, nonirrigated and irrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

193—Pilotpeak-Canwall complex, 3 to 20 percent slopes.

This map unit is on cuesta dip slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 55 percent Pilotpeak cobbly very fine sandy loam and 25 percent Canwall 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 Bruja very cobbly fine sandy loam, Telecan fine sandy loam, and Tieside sandy loam. Also included are small areas of limestone and sandstone Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Pilotpeak soil is very shallow or shallow and well drained. It formed in residuum and colluvium derived dominantly from limestone. Typically the surface layer is 60 percent covered with gravel and cobbles. The surface layer is yellowish brown cobbly very fine sandy loam 4 inches thick. The upper part of the subsoil is brown very cobbly very fine sandy loam 10 inches thick. The lower 4 inches are pale brown extremely cobbly very fine sandy loam. Hard limestone is at a depth of 18 inches. Depth to bedrock ranges from 7 to 20 inches.

Permeability of the Pilotpeak soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is moderate. Winter winds remove the snow from the surface of this soil.

The Canwall soil is moderately deep and well drained. It formed in eolian deposits and colluvium overlying residuum derived from limestone. Typically the surface layer is yellowish brown fine sandy loam 3 inches thick. The upper 9 inches of the subsoil are brown very fine sandy loam. The next 4 inches are brown very cobbly very fine sandy loam. The lower part is very pale brown very cobbly very fine sandy loam about 8 inches thick. Hard limestone is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches. The middle and lower parts of the subsoil contain a high amount of calcium carbonate.

Permeability of the Canwall soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 20 to 40 inches for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root development. Runoff is medium and the hazard of water erosion is severe. The hazard of wind erosion is severe.

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

The potential plant community on the Pilotpeak soil is mainly bluebunch wheatgrass, western wheatgrass, bottlebrush squirreltail, antelope bitterbrush, and black sagebrush. As the range condition deteriorates, juniper, black sagebrush, and threadleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 300 pounds in unfavorable years.

The potential plant community on the Canwall soil is mainly bluebunch wheatgrass, Indian ricegrass, and needleandthread. As the range condition deteriorates, shorter species of grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the low annual precipitation and by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the steepness of slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the cobbly surface layer of the Pilotpeak soil and the hazard of water erosion.

The Pilotpeak soil is in capability subclass VIe, nonirrigated. The Canwall soil is in capability subclass VIe, nonirrigated. The Pilotpeak soil is in the Very Shallow, 10- to 14-inch precipitation, High Plains Southeast range site. The Canwall soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone.

194—Pinelli clay loam, 0 to 6 percent slopes.

This very deep, well drained soil on is terraces, in drainageways of pediments, and in small playas. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Absher loam, Elkol silty clay loam, Forelle loam, and Kemmerer clay loam. Also included are small areas of a moderately deep soil similar to the Pinelli soil. Included areas make up about 25 percent of the total acreage.

Typically the surface layer is light brownish gray clay loam 6 inches thick. The upper part of the subsoil is light brownish gray clay and silty clay 22 inches thick. The lower part to a depth of 60 inches or more is light brownish gray clay loam.

Permeability of the Pinelli 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 slight. The hazard of wind erosion is moderate.

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

The potential plant community on the Pinelli soil is mainly thickspike wheatgrass, green needlegrass, and birdfoot sagebrush. As the range condition deteriorates, forbs and big sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,300 pounds in favorable years to 500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. This soil is well suited to the production of vegetation suitable for livestock grazing.

This soil is well suited for stockwater ponds, mechanical range renovation, and range seeding. The low annual precipitation, however, should be of concern when planning range seedings.

This unit is in capability subclass IVe, nonirrigated. It is in the Clayey, 10- to 14-inch precipitation, High Plains Southeast range site.

195—Pits, mine.

This map unit consists of areas in which the original soil has been totally removed in the mining of gravel for aggregate and the quarrying of limestone for cement. Gravel pits usually are on large stream terraces and quarries are on the older sedimentary bedrock of the Laramie Range. In the gravel pits, most of the gravel is removed usually exposing weakly consolidated bedrock. In quarries, hard bedrock usually is exposed.

A few areas of quarries are in metamorphic rock, which is mined for decorator rock; or in igneous rock, which is mined for titanium and other minerals.

This map unit is in capability subclass VIIIs.

196—Poin-Bowen-Rock outcrop complex, 10 to 50 percent slopes.

This map unit is on mountain slopes. The native vegetation consists mainly of grasses and shrubs, with a few trees. Elevation is 7,600 to 8,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 30 percent Poin very cobbly sandy loam, 15 to 50 percent slopes; 30 percent Bowen gravelly sandy loam, 10 to 20 percent slopes; 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 Rogert fine sandy loam, a very deep very gravelly loamy soil with a calcareous layer, and a very deep very gravelly loamy soil on toe slopes. Included areas make up about 20 percent of the total acreage.

The Poin soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from schist and gneiss. Typically the surface is 30 percent covered with cobbles and stones. The surface layer is dark brown very cobbly sandy loam 6 inches thick. The underlying material is dark grayish brown very channery sandy loam 9 inches thick. Hard schist is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Poin soil is moderately rapid. 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 slight.

The Bowen soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from schist and gneiss. Typically the surface is 20 percent covered with gravel and cobbles. The surface layer is dark brown gravelly sandy loam 8 inches thick. The subsoil is dark yellowish brown very gravelly sandy clay loam and brown very gravelly sandy loam 14 inches thick. The substratum is brown very cobbly sandy loam 9 inches thick. Hard schist is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

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

Rock outcrop consists of exposures of schist, gneiss, and granite.

This unit is used mainly as rangeland and for wildlife habitat. A few areas at the bases of mountain slopes are used for homesites and recreational developments.

The potential plant community on this unit is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

If the Poin and Bowen soils are used for homesites and recreational development, the main limitations are the steepness of slope and the depth to bedrock. Septic tank absorption fields do not function properly if installed in or on the bedrock. Effluent may surface downslope, thus creating a health hazard. The depth to bedrock makes excavating to the depths normally required for construction difficult.

The Poin soil is in capability subclass VIIe, nonirrigated. The Bowen soil is in capability subclass VIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. This unit is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

197—Poposhia-Blazon complex, 3 to 15 percent slopes.

This map unit is on hills. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Poposhia fine sandy loam, 3 to 10 percent slopes and 25 percent Blazon loam, 8 to 15 percent slopes. The Poposhia soil is on foot slopes and lower back slopes of hills. The Blazon soil is on the upper back slopes and shoulders of hills. 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 areas of Chaperton loam and of a soil similar to the Blazon soil, but which is less than 10 inches deep to bedrock. Also included are areas of Blackhall sandy loam and Satanka fine sandy loam. Included areas make up about 25 percent of the total acreage.

The Poposhia soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown fine sandy loam 2 inches thick. The subsoil is brown and very pale brown loam 15 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown loam.

Permeability of the Poposhia 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 severe.

The Blazon soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from interbedded shale and sandstone. Typically the surface layer is pale brown loam 2 inches thick. The underlying material is very pale brown clay loam 10 inches thick. Weakly consolidated platy shale is at a depth of 12 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Blazon 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 severe. The hazard of wind erosion is moderate.

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

The potential plant community on the Poposhia soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Blazon soil is mainly western wheatgrass, bluebunch wheatgrass, mutton bluegrass, bottlebrush squirreltail, and winterfat. As the range condition deteriorates, shorter grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,000 pounds in favorable years to 500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation on the Poposhia soil suitable for livestock grazing is moderately limited by the low annual precipitation. Production on the Blazon soil is limited by the droughtiness of the soil and by the low annual precipitation.

The Poposhia soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Blazon soil is poorly suited for stockwater ponds due to the depth to bedrock. The Poposhia soil is moderately suited for mechanical

range renovation and range seeding; the main limitations are the hazards of wind and water erosion. The Blazon soil is poorly suited for mechanical range renovation and range seeding; the main limitations are the droughtiness of the soil and the hazard of water erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Tillage should be along the contour of the slope.

The Poposhia soil is in capability subclass IVe, nonirrigated. The Blazon soil is in capability subclass VIIs, nonirrigated. The Poposhia soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Blazon soil is in the Shallow Clayey, 10- to 14-inch precipitation, High Plains Southeast range site.

198—Poposhia-Forelle complex, 1 to 8 percent slopes.

This map unit is on fan aprons. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Poposhia loam, 2 to 8 percent slopes and 25 percent Forelle fine sandy loam, 1 to 5 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Chaperton loam, Luhon loam, Rock River sandy loam, and Tisworth sandy clay loam. Included areas make up about 25 percent of the total acreage.

The Poposhia soil is very deep and well drained. It formed in alluvium. Typically the surface layer is light yellowish brown loam 2 inches thick. The subsoil to a depth of 60 inches or more is light yellowish brown clay loam.

Permeability of the Poposhia 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 Forelle soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown fine sandy loam 2 inches thick. The upper part of the subsoil is yellowish brown clay loam 15 inches thick. The lower part to a depth of 60 inches or more is very pale brown and light gray sandy clay loam.

Permeability of the Forelle 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 severe.

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

The potential plant community in this unit is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This unit is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. It is well suited for mechanical range renovation and range seeding. The low annual precipitation, however, should be of concern when planning range seedings.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Platte County near Highway 34 are in similar range sites in the 12- to 14-inch precipitation Southern Plains zone.

199—Poposhia-Chaperton association, 6 to 12 percent slopes.

This map unit is on hills. The native vegetation consists mainly of grasses. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Poposhia loam, 6 to 9 percent slopes and 30 percent Chaperton clay loam, 8 to 12 percent slopes. The Poposhia soil is on crests and foot slopes of hills, while the Chaperton soil is on shoulders and back slopes of hills.

Included in this unit are small areas of Blazon loam on the shoulders and back slopes of hills, Forelle loam and Ryan Park fine sandy loam in drainageways, and Luhon loam on the foot slopes of hills. Included areas make up about 25 percent of the total acreage.

The Poposhia soil is very deep and well drained. It formed in alluvium. Typically the surface layer is dark yellowish brown and yellowish brown loam 5 inches thick. The subsoil is brown and grayish brown loam to a depth of 60 inches or more.

Permeability of the Poposhia 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 Chaperton soil is moderately deep and well drained. It formed in residuum and alluvium derived from shale. Typically the surface layer is pale brown clay loam 3 inches thick. The upper part of the subsoil is brownish gray clay loam 10 inches thick. The lower part is light brownish gray clay loam 12 inches thick. Weakly consolidated shale is at a depth of 25 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Chaperton 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 mainly as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

The Poposhia soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Chaperton soil is poorly suited for stockwater ponds due to the depth to bedrock and slope. This unit is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of water erosion. The low annual precipitation should also be of concern when planning range seedings. To reduce the hazard of erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Tillage should be along the contour of the slope.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch

precipitation Southern Plains zone. Areas of this map unit near the Platte County line near Highway 34 are in similar range sites in the 12- to 14-inch precipitation Southern Plains zone.

200—Rainbolt-Morset association, 3 to 25 percent slopes.

This map unit is on hills. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,400 to 8,200 feet. The annual precipitation is 10 to 17 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 40 percent Rainbolt gravelly sandy loam, 3 to 25 percent slopes and 30 percent Morset gravelly sandy loam, 3 to 10 percent slopes. The Rainbolt soil is on the back slopes and foot slopes of hills. The Morset soil is on the toe slopes of hills.

Included in this unit are small areas of Hapjack gravelly sandy loam, Kezar fine sandy loam, and Wycolo fine sandy loam. Also included are small areas of shallow very gravelly soils. Included areas make up about 30 percent of the total acreage.

The Rainbolt soil is moderately deep and well drained. It formed in alluvium derived dominantly from granitic and sedimentary sources. Typically the surface layer is brown gravelly sandy loam 2 inches thick. The upper part of the subsoil is dark brown and reddish brown gravelly sandy clay loam 14 inches thick. The lower part is reddish brown sandy clay loam 12 inches thick. Weakly consolidated sandstone is at a depth of 28 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Rainbolt 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 Morset soil is very deep and well drained. It formed in alluvium derived from granitic and sedimentary sources. Typically the surface layer is dark grayish brown gravelly sandy loam 2 inches thick. The upper part of the subsoil is dark grayish brown and brown gravelly sandy clay loam 11 inches thick. The next part is very pale brown gravelly sandy clay loam 9 inches thick. The lower part is yellowish brown and light yellowish brown gravelly sandy clay loam to a depth of 60 inches or more.

Permeability of the Morset soil is moderate. 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 mainly as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, prairie junegrass, Griffith

wheatgrass, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, big sagebrush, and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. This unit is well suited to the production of vegetation suitable for livestock grazing.

The Rainbolt soil is poorly suited for stockwater ponds due to the depth to bedrock and slope. The Morset soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. This unit is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of erosion. Tillage should be along the contour of the slope. Tillage for range improvement in areas with a slope of more than 15 percent is not recommended. Interseeding and seedbed preparation by band spraying of herbicides can be used in these areas.

This unit is in capability subclass VIe, nonirrigated. It is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. Some small areas are in the Coarse Loamy, 15- to 19-inch precipitation, High Plains Southeast range site. A few areas are in the Loamy, 10- to 14-inch precipitation, Foothills and Mountains Southeast range site.

201—Redfeather-Lakehelen-Rogert complex, 20 to 50 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of trees, shrubs, and grasses. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 35 percent Redfeather fine sandy loam, 35 percent Lakehelen fine sandy loam, and 20 percent Rogert gravelly 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 Amesmont gravelly fine sandy loam, Hapjack gravelly sandy loam,

and Silas loam. Also included are areas of granite Rock outcrop; a soil similar to the Lakehelen soil, but with weakly consolidated schist at a depth of 20 inches, and small areas of a coarse textured soil in the Jelm Mountain area. Included areas make up about 10 percent of the total acreage.

The Redfeather soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is covered by a 2-inch-thick mat of needles, twigs, and bark in various stages of decomposition. The surface layer is pale brown fine sandy loam 14 inches thick. The subsoil is strong brown very gravelly sandy clay loam 5 inches thick. Hard granite is at a depth of 19 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Redfeather 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 severe. The hazard of wind erosion is severe.

The Lakehelen soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is covered with a 3-inch-thick mat of twigs, needles, and bark in various stages of decomposition. The surface layer is pale brown fine sandy loam 18 inches thick. The subsoil is strong brown very gravelly sandy clay loam 20 inches thick. Hard granite is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Lakehelen soil is moderate. Available water capacity is low. 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 severe.

The Rogert soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 50 percent covered with granitic gravel. The surface layer is brown gravelly sandy loam 4 inches thick. The subsoil is dark brown very gravelly sandy loam 8 inches thick. The substratum is brown very gravelly sandy loam 6 inches thick. Hard granite is at a depth of 18 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Rogert soil is moderately rapid. 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 moderate. Winter winds remove the snow from the surface of this soil.

This unit is used mainly for recreation and for wildlife habitat. Some areas are also used as rangeland or for timber production.

The present vegetation on the Redfeather soil is lodgepole pine with an understory of elk sedge, kinnikinnick, bluegrasses, king spike fescue, rose

pussytoes, low sedge, creeping juniper, antelope bitterbrush, Idaho fescue, western yarrow, cinquefoil, Oregongrape, and violet.

The Redfeather soil is moderately suited to the production of lodgepole pine for timber harvesting. Production of lodgepole pine is 15 to 25 cubic feet per acre per year. Use of this soil for the production and harvesting of timber is limited by the steepness of slope and by the slow growth of the trees.

The present vegetation on the Lakehelen soil is lodgepole pine and Douglas-fir, with an understory of elk sedge, king spike fescue, bluegrasses, kinnikinnick, creeping juniper, aspen, heartleaf arnica, prairie thermopsis, penstemon, geranium, rose pussytoes, Oregongrape, western yarrow, Idaho fescue, Columbia needlegrass, cinquefoil, stonecrop, and larkspur.

The Lakehelen soil is moderately suited to the production of lodgepole pine and Douglas-fir for timber harvesting. Production of the lodgepole pine is 25 to 35 cubic feet per acre per year. Production of Douglas-fir is 20 to 30 cubic feet per acre per year. Use of this soil for the production and harvesting of timber is limited by the steepness of slope and by the slow growth of the trees.

The potential plant community on the Rogert soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

Production of vegetation suitable for livestock grazing on the Redfeather and Lakehelen soils is severely limited by the dense tree cover, which limits the growth of the understory. Production on the Rogert soil is moderately limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

This unit is in capability subclass VIIe, nonirrigated. The Redfeather and Lakehelen soils are in a woodland site. The Rogert soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

202—Redrob loam, 0 to 2 percent slopes.

This very deep, poorly drained soil is on flood plains and low stream terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation

is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Glendive loam and the frequently flooded Redrob loam. Also included are small areas of a soil with a thicker surface layer and a slightly higher salinity. Included areas make up about 15 percent of the total acreage.

Typically the upper part of the surface layer is slightly saline very dark grayish brown loam 7 inches thick. The next 16 inches are slightly saline dark grayish brown loam. The upper 10 inches of the underlying material are slightly saline brown loam. The lower part to a depth to a depth of 60 inches or more is light brownish gray very gravelly sand.

Permeability of the Redrob soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is 10 to 20 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. From March through August, a seasonal high water table fluctuates between 1 and 2 feet. During the remainder of the year, depth to the water table is between 1.5 and 3.5 feet. This soil is subject to a rare hazard of flooding.

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

If this unit is used for hay and pasture, the main limitations are the wetness and the slight salinity of the soil. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Redrob soil is mainly alkali sacaton, basin wildrye, and alkali bluegrass. As the range condition deteriorates, inland saltgrass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the wetness and salinity of the soil. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This soil is well suited for stockwater ponds. Pits dug sufficiently deeper than the level of the water table can provide water for livestock. Due to the seepage potential of the soil, pits and other ponds will not hold water above the level of the water table for a long period of time. This soil is poorly suited for mechanical range renovation and range seeding; the main limitations are wetness and salinity of the soil. Use of equipment on this soil is limited to the period of the year when the water table is at its deepest level. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity of the soil.

This unit is in capability subclass IVw, nonirrigated and irrigated. It is in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site.

203—Redrob, frequently flooded-Grenoble-Redrob complex, 0 to 3 percent slopes.

This map unit is on flood plains and low stream terraces. (See figure 6.) The native vegetation consists mainly of grasses and sedges. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Redrob loam, frequently flooded; 35 percent Grenoble gravelly sandy loam; and 15 percent Redrob very 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 Gerrard loam, Glendive loam, and Riverwash. Included areas make up about 10 percent of the total acreage.

The Redrob, frequently flooded soil is very deep and poorly drained. It formed in alluvium. Typically the surface layer is slightly saline dark grayish brown loam 14 inches thick. The upper 9 inches of the underlying material are stratified brown loam and fine sandy loam and is slightly saline. The lower part to a depth of 60 inches or more is light yellowish brown very gravelly sand.

Permeability of the Redrob, frequently flooded soil is moderate in the upper part and very rapid in the lower



Figure 6.—An area along the Laramie River of the detailed soil map unit of Redrob, frequently flooded-Grenoble-Redrob complex, 0 to 3 percent slopes.

part. Available water capacity is low. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 0 to 18 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between 0 and 18 inches from March through August. This soil is subject to frequent brief periods of flooding from May through June.

The Grenoble soil is very deep and somewhat poorly drained. It formed in alluvium. Typically the surface is 35 percent covered with fine gravel. The surface layer is grayish brown gravelly sandy loam 5 inches thick. The upper part of the underlying material is light yellowish brown very gravelly loamy sand 20 inches thick. The lower

part to a depth of 60 inches or more is light yellowish brown very gravelly sand.

Permeability of the Grenoble soil is very rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 24 to 42 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is moderate. The hazard of wind erosion is moderate. A seasonal high water table is at a depth of 24 and 41 inches from March through August. This soil is subject to frequent brief periods of flooding from May through June.

The Redrob soil is very deep and poorly drained. It formed in alluvium. Typically the upper part of the surface

layer is slightly saline brown very fine sandy loam 5 inches thick. The lower part is slightly saline very dark grayish brown loam 16 inches thick. The upper part of the underlying material is brown loam 17 inches thick. The lower part to a depth of 60 inches or more is strong brown very gravelly loamy sand.

Permeability of the Redrob soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 12 to 24 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe. From March through August, the water table fluctuates between a depth of 1 and 2 feet. The water table is between 2 and 4 feet during the remainder of the year. This soil is subject to a rare hazard of flooding.

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

If this unit is used for hay and pasture, the main limitations are wetness and slight salinity of the soil. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Redrob soils is mainly alkali sacaton, basin wildrye, and alkali bluegrass. As the range condition deteriorates, inland saltgrass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years.

The potential plant community on the Grenoble soil is mainly alkali sacaton, basin wildrye, inland saltgrass, and western wheatgrass. As the range condition deteriorates, greasewood and inland saltgrass increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500

pounds in favorable years to 1,200 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Production of vegetation suitable for livestock grazing is limited by the salinity and wetness of the soils.

This unit is well suited for stockwater ponds. Pits dug sufficiently deeper than the level of the water table can provide water for livestock. Due to the seepage potential of the soils, pits and other ponds will not hold water above the level of the water table for a long period of time. Because the water table is at a more shallow depth in the Redrob soil than the other soils, it is better suited for these pits. This unit is poorly suited for mechanical range renovation and range seeding; the main limitations are wetness and salinity of the soils. Use of equipment on this soil is limited to the period of the year when the water table is at its deepest level. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity of the soils.

The Redrob, frequently flooded soil is in capability subclass VIw, nonirrigated and irrigated. The Grenoble soil is in capability subclass VIi, nonirrigated and irrigated. The Redrob soil is in capability subclass IVw, nonirrigated and irrigated. The Redrob soils are in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site. The Grenoble soil is in the Saline Lowland, 10- to 14-inch precipitation, High Plains Southeast range site.

204—Redrob, frequently flooded-Redrob loams, 0 to 3 percent slopes.

This map unit is on flood plains and low stream terraces. The native vegetation consists mainly of grasses and grasslike plants. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Redrob loam, frequently flooded, and 35 percent Redrob loam. The Redrob loam, frequently flooded soil is in low areas and sloughs with slopes of 0 to 2 percent. The Redrob loam is on the slightly higher areas with slopes of 1 to 3 percent. 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 Grenoble gravelly sandy loam, Riverwash, and a soil similar to Redrob loam but with a thicker surface layer. Also included are soils with a slightly saline surface layer. Included areas make up about 20 percent of the total acreage.

The Redrob, frequently flooded soil is very deep and poorly drained. It formed in alluvium. Typically the upper part of the surface layer is slightly saline grayish brown loam 3 inches thick. The lower 20 inches are slightly saline very dark gray loam. The upper part of the underlying material is slightly saline grayish brown loam and sandy clay loam 12 inches thick. The lower part to a depth of 60 inches or more is light olive brown very gravelly sand.

Permeability of the Redrob, frequently flooded soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is 5 to 18 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. From March through August, a water table fluctuates between 0 and 1.5 feet. During the remainder of the year, the water table is between 1.5 and 3 feet. This soil is subject to brief, frequent periods of flooding from May through June.

The Redrob soil is very deep and poorly drained. It formed in alluvium. Typically the surface layer is slightly saline grayish brown and very dark grayish brown loam 18 inches thick. The upper 7 inches of the underlying material are slightly saline light olive brown sandy clay loam. The lower part to a depth of 60 inches or more is very gravelly sand stratified with thin lenses of sand.

Permeability of this Redrob soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 30 to 40 inches for water-tolerant plants, but it is only 12 to 24 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. From March through August, a water table fluctuates between a depth of 1 and 2 feet. The water table is between 1.5 and 3.5 feet during the remainder of the year. This soil is subject to a rare hazard of flooding.

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

If this unit is used for hay and pasture, the main limitations are wetness and slight salinity of the soil.

Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Redrob soils is mainly alkali sacaton, basin wildrye, and alkali bluegrass. As the range condition deteriorates, inland saltgrass and greasewood increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 3,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 3,400 pounds in favorable years to 2,500 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of plant species is maintained in the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Production of vegetation suitable for livestock grazing is limited by the salinity and wetness of the soils.

This unit is well suited for stockwater ponds. Pits dug sufficiently deeper than the level of the water table can provide water for livestock. Due to the seepage potential of the soils, pits or other ponds will not hold water above the level of the water table for a long period of time. This unit is poorly suited for mechanical range renovation and range seeding; the main limitations are wetness and salinity of the soils. Use of equipment on this soil is limited to the period of the year when the water table is at its deepest level. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity of the soils.

The Redrob, frequently flooded soil is in capability subclass VIw, nonirrigated and irrigated. The Redrob soil is in capability subclass IVw, nonirrigated and irrigated. This unit is in the Saline Subirrigated, 10- to 14-inch precipitation, High Plains Southeast range site.

205—Redrob, frequently flooded-Redrob-Urban land complex, 0 to 3 percent slopes.

This map unit is on flood plains and low stream terraces. The native vegetation consists mainly of grass and grass-like plants. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Redrob loam, frequently flooded; 25 percent Redrob very fine sandy loam; and 20 percent Urban land. 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 Gerrard loam, Glendive loam, and Grenoble gravelly sandy loam. Also included are small areas of Riverwash. Included areas make up about 20 percent of the total acreage.

The Redrob, frequently flooded soil is very deep and poorly drained. It formed in alluvium. Typically the surface layer is slightly saline dark grayish brown loam 14 inches thick. The upper part of the underlying material is slightly saline stratified brown loam and fine sandy loam 9 inches thick. The lower part to a depth of 60 inches or more is light yellowish brown very gravelly sand.

Permeability of the Redrob, frequently flooded soil is moderate in the upper part and very rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches for water-tolerant plants, but it is only 5 to 18 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. From March through August, a seasonal high water table fluctuates between 0 and 1.5 feet. During the remainder of the year, the water table is between 1.5 and 3.5 feet. This soil is subject to brief, frequent flooding from May through June.

The Redrob soil is very deep and poorly drained. It formed in alluvium. Typically the upper part of the surface layer is slightly saline brown very fine sandy loam 5 inches thick. The next part is slightly saline very dark grayish brown loam 15 inches thick. The upper part of the underlying material is slightly saline brown loam 18 inches thick. The lower part to a depth of 60 inches or more is brownish yellow very gravelly loamy sand.

Permeability of the Redrob soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 12 to 24 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe. From March through August, the water table fluctuates between 1 and 2 feet. During the remainder of the year, the water table is

between 1.5 and 3.5 feet. This soil is subject to a rare hazard of flooding.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If this unit is used for urban development, the main limitations are the the high water table and the hazard of flooding. Due to the hazard of flooding, use of this unit as a site for buildings is not recommended. In addition, use of this soil as a site for buildings with basements is not recommended due to the high water table. Septic tank absorption fields buried in these soils do not function properly due the high water table. In addition, if several septic systems are installed in an area, the water added to the soil may raise the level of the water table.

The Redrob, frequently flooded soil is in capability subclass VIw, nonirrigated. The Redrob soil in in capability subclass IVw, nonirrigated.

206—Rentsac-Wycolo complex, 2 to 15 percent slopes.

This map unit is on cuesta dip slopes and structural benches. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,200 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Rentsac channery sandy loam, 2 to 15 percent slopes and 35 percent Wycolo sandy loam, 2 to 10 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Almy loam, Thermopolis fine sandy loam, and a soil similar to the Wycolo soil but which is 10 to 20 inches deep to bedrock. Also included are small areas of sandstone Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Rentsac soil is shallow and well drained. It formed in residuum derived dominantly from sandstone. Typically the surface is 20 percent covered with channery fragments and a few flagstones. The surface layer is yellowish brown channery sandy loam 3 inches thick. The subsoil is yellowish brown very channery sandy loam 3 inches thick. The substratum is brown extremely channery sandy loam 8 inches thick. Hard sandstone is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches. This soil is outside the characteristics of the

Rentsac series because it does not contain calcium carbonate. This difference, however, does not significantly affect the use or management of this soil.

Permeability of the Rentsac soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid and the hazard of water erosion is medium. The hazard of wind erosion is moderate.

The Wycolo soil is moderately deep and well drained. It formed in alluvium derived dominantly from interbedded sandstone and shale. Typically the surface layer is strong brown sandy loam 7 inches thick. The subsoil is yellowish red sandy clay loam 9 inches thick. The substratum is pink sandy loam 7 inches thick. Weakly consolidated yellowish sandstone is at a depth of 23 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Wycolo soil is moderate. Available water capacity is very 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.

This unit is used mainly as rangeland. It is also used for wildlife habitat and as a source of flagstones.

The potential plant community on the Rentsac soil is mainly bluebunch wheatgrass, bottlebrush squirreltail, and western wheatgrass. As the range condition deteriorates, black sagebrush and threadleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 250 pounds in unfavorable years.

The potential plant community on the Wycolo soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Rentsac soil is limited by the droughtiness of the soil and by the low annual precipitation; production on the Wycolo soil is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. The Rentsac soil is poorly suited for mechanical range renovation and range seeding; the main limitations are the rock fragments in the surface layer and the hazards of wind and water erosion. The Wycolo soil is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope.

The Rentsac soil is in capability subclass VII_s, nonirrigated. The Wycolo soil is in capability subclass IV_e, nonirrigated. The Rentsac soil is in the Very Shallow, 10- to 14-inch precipitation, High Plains Southeast range site. The Wycolo soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation Southern Plains zone.

207—Renvers-Chalkhill complex, 1 to 15 percent slopes.

This map unit is on cuesta dip slopes. The native vegetation consists mainly of shrubs and grasses. Elevation is 7,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Renvers very stony loam, 3 to 15 percent slopes and 40 percent Chalkhill sandy loam, 1 to 15 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blazon loam, Rentsac channery sandy loam, and Rock outcrop. Also included are areas of a moderately deep soil similar to the Chalkhill soil. Included areas make up about 20 percent of the total acreage.

The Renvers soil is very shallow and well drained. It formed in alluvium and residuum derived from sandstone. Typically the surface is 35 percent covered with stones and cobbles and 15 percent covered with gravel. The surface layer is pale brown very stony loam 1 inch thick. The underlying material is brown very stony fine sandy loam 3 inches thick. Hard sandstone is at a depth of 4 inches. Depth to bedrock ranges from 4 to 10 inches.

Permeability of the Renvers soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 4 to 10 inches. Runoff is medium and the hazard

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

The Chalkhill soil is shallow and well drained. It formed in alluvium overlying residuum derived from sandstone. Typically the surface is 30 percent covered with sandstone channery fragments. The surface layer is light yellowish brown sandy loam 2 inches thick. The upper part of the subsoil is brown sandy clay loam 9 inches thick. The lower part is brown extremely channery sandy clay loam 3 inches thick. Hard sandstone is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Chalkhill soil is moderate. 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 severe.

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

The potential plant community on the Renvers soil is mainly bluebunch wheatgrass, western wheatgrass, and bottlebrush squirreltail. As the range condition deteriorates, black sagebrush and threadleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 250 pounds in unfavorable years.

The potential plant community on the Chalkhill soil is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, and black sagebrush. As the range condition deteriorates, threadleaf sedge and sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils and by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding. The main limitations are the rock fragments on the surface of the soil, droughtiness of the soil, and the hazards of wind and water erosion.

This unit is in capability subclass VII_s, nonirrigated. The Renvers soil is in the Very Shallow, 10- to 14-inch

precipitation, High Plains Southeast range site. The Chalkhill soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

208—Rimton-Passcreek, cobbly subsoil-Miracle complex, 10 to 60 percent slopes.

This map unit is on north facing mountain slopes and canyon sides. The native vegetation consists mainly of trees, shrubs, and grasses. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 40 percent Rimton very fine sandy loam, 10 to 60 percent slopes; 25 percent Passcreek fine sandy loam, cobbly subsoil, 10 to 60 percent slopes; and 15 percent Miracle fine sandy loam, 10 to 40 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Cheadle sandy loam and Nathale gravelly fine sandy loam. Also included are small areas of limestone Rock outcrop and a coarse textured soil similar to the Rimton soil. Included areas make up about 20 percent of the total acreage.

The Rimton soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from interbedded limestone and sandstone. Typically the surface is covered with a 2-inch-thick mat of needles, twigs, and bark. The surface layer is very dark gray very fine sandy loam 4 inches thick. The subsurface layer is yellowish brown fine sandy loam 11 inches thick. The upper 9 inches of the subsoil are strong brown sandy clay loam. The next 8 inches are yellowish red sandy clay loam. The lower part is yellowish red very cobbly fine sandy loam 7 inches thick. Interbedded fractured sandstone and limestone are at a depth of 39 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Rimton soil is moderate. Available water capacity is low. 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 Passcreek soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from interbedded limestone and sandstone. Typically the surface is 5 to 10 percent covered with cobbles. The surface layer is brown fine sandy loam 7 inches thick. The upper part of the subsoil is strong brown cobbly fine sandy loam 10 inches thick. The lower part is strong brown very cobbly fine sandy loam 9 inches thick. Hard limestone is at a depth of 26 inches. Depth to bedrock ranges from 20 to 40 inches.

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

The Miracle soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from sandstone and shale. Typically the surface layer is brown fine sandy loam 6 inches thick. The upper 5 inches of the subsoil are brown sandy clay loam. The next part is strong brown sandy clay loam 15 inches thick. The lower part is yellowish red sandy clay loam 5 inches thick. Hard reddish sandstone is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Miracle soil is moderate. Available water capacity is low. 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 severe.

Most areas of this unit are used for wildlife habitat and recreation. A few areas are used as rangeland.

The present plant community on the Rimton soil is mainly Douglas-fir and an understory of spike fescue, mountain brome, Idaho fescue, elk sedge, currant, Rocky Mountain maple, yarrow, wheatgrasses, Columbia needlegrass, bedstraw, bluegrasses, lupine, heartleaf arnica, bluebells, strawberry, Woods rose, cinquefoil, and creeping juniper. A few areas have a plant community of limber pine and an understory of common juniper, bluebunch wheatgrass, and snowberry.

The potential plant community on the Passcreek soil is mainly bluebunch wheatgrass, Griffith wheatgrass, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Miracle soil is mainly bluebunch wheatgrass, prairie junegrass, Griffith wheatgrass, and Idaho fescue. As the range condition deteriorates, blue grama, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 1,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,000 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while 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; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Passcreek soil is limited by the droughtiness of the soil; the Miracle soil is well suited to this production.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Rimton soil is poorly suited to the production of Douglas-fir for timber harvesting. Production of the Douglas-fir is 15 to 25 cubic feet per acre per year. Use of this soil for timber production and harvesting is limited because of the steepness of slope and the very slow growth of the trees.

This unit is in capability subclass VIIe, nonirrigated. The Rimton soil is in the Douglas-fir woodland site. The Passcreek soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast. The Miracle soil is in the Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

209—Riverwash.

This unit consists of areas of sandy and gravelly sediments that are frequently flooded and worked by rivers. This unit occurs on flood plains and in stream channel areas where river velocities are relatively rapid. Vegetation is usually absent; however, willows, annual forbs, and small cottonwoods grow on the more stable positions. Slope is 0 to 2 percent. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

These areas have a water table that is at or near the surface during and shortly after periods of flooding. In most areas, the water table is always above a depth of 3.5 feet.

Included in this unit are small areas of Canburn loam, Cattle loam, Gerrard loam, Glendive sandy loam, Grenoble gravelly sandy loam, Redrob loam, and frequently flooded Redrob loam. These included soils occur on the more stable areas of the unit. The size of included areas are so small, and occur in such a complex arrangement, that it was not practical to map them separately at the scale used. Included areas make up about 40 percent of the total acreage.

This unit is used mainly for wildlife habitat and for recreation.

This unit is capability class VIII.

210—Rock outcrop-Bonjea complex, 40 to 60 percent slopes.

This map unit is on mountain slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Rock outcrop and 30 percent Bonjea 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 Boyle gravelly sandy loam, Chugcreek sandy loam, Linger loam, and a very shallow soil similar to the Cathedral soil. Included areas make up about 20 percent of the total acreage.

Rock outcrop consists of exposures of granite and gneiss.

The Bonjea soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite and gneiss. Typically the surface layer is brown sandy loam 3 inches thick. The upper 10 inches of the subsoil are brown sandy clay loam. The lower 4 inches are dark yellowish brown gravelly sandy clay loam. Hard granite is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Bonjea 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 severe. The hazard of wind erosion is severe.

This unit is used mainly for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, threetip sagebrush, and slimstem muhly. As the range condition deteriorates, threadleaf sedge and low rabbitbrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 550 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Bonjea soil and by the amount of Rock outcrop in the unit. Steepness of the slope severely limits access to this unit by livestock.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

Rock outcrop is in capability subclass VIII. The Bonjea soil is in capability subclass VIIe, nonirrigated. The Bonjea soil is in the Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

211—Rock outcrop-Bruja-Byrnie complex, 30 to 70 percent slopes.

This map unit is on escarpments. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 30 percent Rock outcrop; 25 percent Bruja very cobbly fine sandy loam, 30 to 50 percent slopes; and 25 percent Byrnie gravelly fine sandy loam, 40 to 70 percent slopes. The Bruja soil is on lower slopes and in concave areas. The Byrnie soil is on steeper slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Canwall fine sandy loam, Joemre fine sandy loam, and Pilotpeak cobbly very fine sandy loam. Also included are small areas with a 1- or 2-inch-thick mantle of very channery sandy loam over bedrock. Included areas make up about 20 percent of the total acreage.

Rock outcrop consists of exposures of limestone, red sandstone, and shale.

The Bruja soil is moderately deep and well drained. It formed in residuum and colluvium derived from interbedded sandstone and limestone. Typically the surface is 70 percent covered with cobbles. The surface layer is dark yellowish brown very cobbly fine sandy loam 2 inches thick. The upper part of the subsoil is yellowish brown very cobbly very fine sandy loam 8 inches thick. The lower part is brown and light reddish brown very cobbly very fine sandy loam 13 inches thick. Fractured sandstone is at a depth of 23 inches. Depth to bedrock ranges from 20 to 40 inches. The lower part of the subsoil contains a high amount of calcium carbonate.

Permeability of the Bruja soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 20 to 40 inches for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Byrnie soil is shallow and well drained. It formed in residuum and colluvium derived from interbedded sandstone and limestone. Typically the surface is about 25 percent covered with gravel and cobbles. The surface layer is strong brown gravelly fine sandy loam 2 inches thick. The subsoil is light brown and strong brown gravelly fine sandy loam 10 inches thick. Weakly consolidated interbedded sandstone, limestone, and shale is at a

depth of 12 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Byrnie soil is moderately rapid. 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.

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

The potential plant community on the Bruja soil is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, and mountainmahogany. As the range condition deteriorates, threadleaf sedge, rabbitbrush, and shorter grass species increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 600 pounds of air-dry vegetation per acre in normal years. Production ranges from 800 pounds in favorable years to 350 pounds in unfavorable years.

The potential plant community on the Byrnie soil is mainly bluebunch wheatgrass, Indian ricegrass, threadleaf sedge, mutton bluegrass, and needleandthread. As the range condition deteriorates, shorter species of grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Byrnie soil and by the amount of Rock outcrop in the unit. Steepness of the slope severely limits access by livestock to this unit.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

Rock outcrop is in capability subclass VIIIs. The Bruja and Byrnie soils are in capability subclass VIIe, nonirrigated. The Bruja soil is in the Rocky Hills, 10- to 14-inch precipitation, High Plains Southeast range site. The Byrnie soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

212—Rock outcrop-Cathedral complex, 20 to 40 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses, shrubs, and a few widely scattered trees. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Rock outcrop and 30 percent Cathedral very stony coarse 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 Alderon gravelly sandy loam, Boyle gravelly sandy loam, and Lininger loam. Included areas make up about 20 percent of the total acreage.

Rock outcrop consists of exposures of highly weathered granite saprolite and nearly vertical hard granitic blocks.

The Cathedral soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is about 70 percent covered with gravel, cobbles, stones, and boulders. The surface layer is dark grayish brown very stony coarse sandy loam 2 inches thick. The underlying material is dark brown very gravelly coarse sandy loam 11 inches thick. Hard granite is at a depth of 13 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Cathedral soil is rapid. 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 slight. Winter winds remove the snow from the surface of this soil.

This unit is used mainly for wildlife habitat and for recreation. A few areas are used for livestock grazing.

The potential plant community on the Cathedral soil is mainly bluebunch wheatgrass, black sagebrush, threetip sagebrush, and slimstem muhly. As the range condition deteriorates, threadleaf sedge and low rabbitbrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 550 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years. Production of vegetation suitable for

livestock grazing is limited by the droughtiness of the Cathedral soil and by the amount of Rock outcrop in the unit. Steepness of the slope limits access by livestock to this unit.

Rock outcrop is in capability subclass VIIIs. The Cathedral soil is in capability subclass VIIe, nonirrigated. The Cathedral soil is in the Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

213—Rock outcrop-Cathedral-Alderon complex, 25 to 50 percent slopes.

This map unit is on mountain slopes. The native vegetation consists mainly of grasses, shrubs, and trees. Elevation is 6,000 to 7,800 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Rock outcrop; 20 percent Cathedral very gravelly sandy loam, 25 to 40 percent slopes; and 20 percent Alderon sandy loam, 25 to 50 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Boyle gravelly sandy loam and Lininger loam. Included areas make up about 20 percent of the total acreage.

Rock outcrop consists of exposures of hard granite and highly weathered granite saprolite. It includes very large granite boulders.

The Cathedral soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 50 percent covered with small granitic gravel. The surface layer is dark brown very gravelly sandy loam 2 inches thick. The underlying material is dark brown very gravelly coarse sandy loam 8 inches thick. Hard granite is at a depth of 10 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Cathedral soil is rapid. 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 slight. Winter winds remove the snow from the surface of this soil.

The Alderon soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from granite. Typically the surface is covered with a 2-inch-thick mat of needles, twigs, and bark. The surface layer is very dark grayish brown sandy loam 2 inches thick. The subsurface layer is light brown sandy clay loam 5 inches thick. The subsoil is yellowish red gravelly sandy clay loam 19 inches thick. The substratum is brown very

gravelly coarse sandy loam 13 inches thick. Weakly consolidated granite is at a depth of 39 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Alderon soil is moderate. Available water capacity is low. 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 severe.

Most areas of this unit are used for wildlife habitat. A few areas are also used as rangeland.

The potential plant community on the Cathedral soil is mainly bluebunch wheatgrass, black sagebrush, threetip sagebrush, and slimstem muhly. As the range condition deteriorates, threadleaf sedge and low rabbitbrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 550 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

The present vegetation on the Alderon soil is lodgepole pine and an understory of king spike fescue, elk sedge, low sedge, heartleaf arnica, Rocky Mountain maple, creeping juniper, currant, snowberry, antelope bitterbrush, mountain brome, bluebells, western yarrow, kinnikinnick, rose pussytoes, Richardson's geranium, bedstraw, and Woods rose.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Slope limits access by livestock to this unit. Grazing also should be managed to protect the unit from excessive erosion.

Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Cathedral soil; by the dense tree cover on the Alderon soil, which limits the growth of the understory vegetation; and by the amount of Rock outcrop in the unit. This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Alderon soil is moderately suited to the production of lodgepole pine for timber harvesting. Production of lodgepole pine is 25 to 35 cubic feet per acre per year. The site index for lodgepole pine ranges from 35 to 60. Use of this soil for timber production and harvesting is limited because of the steepness of slope and the slow growth of the trees.

Rock outcrop is in capability subclass VIIIs. The Cathedral and Alderon soils are in capability subclass VIIe, nonirrigated. The Cathedral soil is in the Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Alderon soil is in a woodland site.

214—Rock outcrop-Pilotpeak complex, 3 to 25 percent slopes.

This map unit is on cuesta dip slopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Rock outcrop and 25 percent Pilotpeak cobbly 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 Bruja very cobbly fine sandy loam, Canwall fine sandy loam, and a soil similar to the Pilotpeak soil but which contains seams of gypsum. Included areas make up about 25 percent of the total acreage.

Rock outcrop consists of exposures of fractured limestone bedrock.

The Pilotpeak soil is very shallow or shallow and well drained. It formed in residuum and colluvium derived dominantly from limestone. Typically the surface is 20 percent covered with cobbles and gravel. The surface layer is brown cobbly fine sandy loam 4 inches thick. The subsoil is brown very cobbly very fine sandy loam 7 inches thick. Hard limestone is at a depth of 11 inches. Depth to bedrock ranges from 7 to 20 inches.

Permeability of the Pilotpeak soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is moderate. Winter winds remove the snow from the surface of this soil.

This unit is used for wildlife habitat and as rangeland.

The potential plant community on the Pilotpeak soil is mainly bluebunch wheatgrass, western wheatgrass, bottlebrush squirreltail, black sagebrush, and antelope bitterbrush. As the range condition deteriorates, juniper, black sagebrush, and threadleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 250 pounds in unfavorable years.

Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Pilotpeak soil and by the amount of Rock outcrop in this unit. This unit is poorly suited for stockwater ponds, mechanical range renovation, or range seeding due to the amount of Rock outcrop in the unit, the cobbles in the surface layer, and the depth to bedrock in the Pilotpeak soil.

Rock outcrop is in capability subclass VIIIc. The Pilotpeak soil is in capability subclass VIIe, nonirrigated. The Pilotpeak soil is in the Very Shallow, 10- to 14-inch

precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in a similar range site in the 15- to 17-inch precipitation Southern Plains zone.

215—Rock outcrop-Rogert complex, 25 to 99 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses, shrubs, and a few scattered trees. Elevation is 7,600 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 60 percent Rock outcrop and 20 percent Rogert gravelly 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 Lakehelen fine sandy loam, Amesmont fine sandy loam, Hapjack gravelly sandy loam, Poin sandy loam, and a very shallow soil similar to the Rogert soil. Included areas make up about 20 percent of the total acreage.

Rock outcrop consists of exposures of hard granite and highly weathered granite saprolite.

The Rogert soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 25 percent covered with cobbles and small granitic gravel. The surface layer is dark brown gravelly fine sandy loam 4 inches thick. The subsoil is brown very gravelly sandy loam 7 inches thick. Hard granite is at a depth of 11 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Rogert soil is moderately rapid. 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. Winter winds remove the snow from the surface of this soil.

This unit is used mainly for wildlife habitat. It is also used for recreation and for limited livestock grazing.

The potential plant community on the Rogert soil is mainly bluebunch wheatgrass, threetip sagebrush, black sagebrush, and slimstem muhly. As the range condition deteriorates, threadleaf sedge and low rabbitbrush increase. As the range condition further deteriorates, broom snakeweed and annuals invade. The potential plant community produces about 550 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less

preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the amount of Rock outcrop in this unit and by the droughtiness of the Rogert soil. Steepness of the slope severely limits access by livestock to many areas of this unit.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

Rock outcrop is in capability subclass VIII_s. The Rogert soil is in capability subclass VII_e, nonirrigated. The Rogert soil is in the Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

216—Rock River sandy loam, 2 to 6 percent slopes.

This very deep, well drained soil is on alluvial fans and terraces. It formed in alluvium. The native vegetation consists mainly of grasses. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Alcova sandy loam, Forelle loam, and Stunner sandy loam. Also included are small areas of Borollic Camborthids soils. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is pale brown sandy loam 3 inches thick. The upper part of the subsoil is yellowish brown and brown sandy clay loam 14 inches thick. The lower part is brown fine sandy loam to a depth of 60 inches or more.

Permeability of the Rock River 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 severe.

This unit is used as rangeland and for wildlife habitat. A few areas near Laramie and Rock River are used for irrigated hay and pasture.

The potential plant community on the Rock River soil is western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas where there is more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is well suited to irrigated hay and pasture. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs. Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

This unit is in capability subclass IV_e, nonirrigated and irrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

217—Rock River loam, 1 to 8 percent slopes, bouldery.

This very deep, well drained soil is on alluvial fan aprons. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Twocabin gravelly loam, Forelle loam, and Cushool sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface is about 1 percent covered with boulders and about 5 percent covered with gravel. The surface layer is yellowish brown loam 3 inches thick. The upper part of the subsoil is brown sandy clay loam 18 inches thick. The lower part is pale yellow sandy loam to a depth of 60 inches or more.

Permeability of the Rock River 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.

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

The potential plant community on the Rock River soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is poorly suited for mechanical range renovation and range seeding due to the boulders on the surface of the soil. Brush control may be needed in areas where there is more brush than would be present in the potential plant community; prescribed burning or aerial application of herbicides would be good methods of brush control.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

218—Rock River-Urban land complex, 0 to 6 percent slopes.

This map unit is on alluvial and strath terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 55 percent Rock River sandy loam and 25 percent Urban land. 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 Alcova sandy loam, Forelle loam, and Stunner sandy loam. Also included are small areas of Borollic Camborthids soils. Included areas make up about 20 percent of the total acreage.

The Rock River soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown sandy loam 3 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam 14 inches thick. The lower part is brown fine sandy loam to a depth of 60 inches or more.

Permeability of the Rock River 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 severe.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

This unit is well suited to urban development. It has few limitations.

The Rock River soil is in capability subclass IVe, nonirrigated.

219—Rogert-Lakehelen-Rock outcrop complex, 8 to 40 percent slopes.

This map unit is on mountain slopes. The native vegetation consists mainly of grasses, shrubs, and trees. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 30 percent Rogert gravelly sandy loam, 8 to 25 percent slopes; 30 percent Lakehelen sandy loam, 8 to 40 percent slopes; 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 Amesmont fine sandy loam, Hapjack gravelly sandy loam, Vensora very fine sandy loam, and a very shallow soil similar to the Rogert soil. Included areas make up about 20 percent of the total acreage.

The Rogert soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 20 percent covered with small granitic gravel. The surface layer is dark brown gravelly sandy loam 3 inches thick. The subsoil is dark brown very gravelly sandy loam 8 inches thick. The substratum is brown very gravelly sandy loam 5 inches thick. Hard granite is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Rogert soil is moderately rapid. 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. Winter winds remove the snow from the surface of this soil.

The Lakehelen soil is moderately deep and well drained. It formed in colluvium and residuum derived from granite. Typically the surface is covered with a 1-inch-thick mat of needles and twigs. The surface layer is brown and light yellowish brown sandy loam 15 inches thick. The subsoil is dark yellowish brown very gravelly sandy clay loam 12 inches thick. Hard granite is at a depth of 27 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Lakehelen soil is moderate. Available water capacity is very low. 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 severe.

Rock outcrop consists of exposures of hard granite and highly weathered granite saprolite.

This unit is used mainly as rangeland and for wildlife habitat. It is also used for recreation and for limited harvesting of wood products.

The potential plant community on the Rogert soil is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

The present vegetation on the Lakehelen soil is lodgepole pine or Douglas-fir and an understory of elk sedge, king spike fescue, bluegrasses, kinnikinnick, creeping juniper, aspen, heartleaf arnica, prairie thermopsis, penstemon, geranium, rose pussytoes, Oregongrape, western yarrow, Idaho fescue, Columbia needlegrass, cinquefoil, stoncrop, and larkspur.

Production of vegetation on the Rogert soil suitable for livestock grazing is limited by the droughtiness of the soil. Production on the Lakehelen soil is limited by the dense tree cover, which limits the growth of the understory vegetation.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Lakehelen soil is moderately suited to the production of lodgepole pine or Douglas-fir for timber

harvesting. Production of lodgepole pine is 25 to 35 cubic feet per acre per year. Production of Douglas-fir is 20 to 30 cubic feet per acre per year. Use of this soil for timber production and harvesting is limited because of the steepness of slope and the slow growth of the trees.

The Rogert soil is in capability subclass VIIe, nonirrigated. The Lakehelen soil is in capability subclass VIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Rogert soil is in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Lakehelen soil is in a woodland site.

220—Rogert-Rock outcrop-Amesmont complex, 5 to 25 percent slopes.

This map unit is on foothills and mountain slopes. The native vegetation consists mainly of grasses, shrubs, and a few scattered trees. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 45 percent Rogert gravelly sandy loam, 5 to 25 percent slopes; 25 percent Rock outcrop; and 15 percent Amesmont sandy loam, 5 to 15 percent slopes. The Rogert soils are on the convex slopes and the Amesmont soils are on concave slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Dalecreek sandy loam, Lakehelen sandy loam, a soil similar to the Amesmont soil, but with a less pronounced subsoil, and a very shallow soil similar to the Rogert soil. Included areas make up about 15 percent of the total acreage.

The Rogert soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from granite. Typically the surface is 50 percent covered with small granitic gravel. The surface layer is brown gravelly sandy loam 4 inches thick. The subsoil is dark brown very gravelly sandy loam 7 inches thick. The substratum is dark brown very gravelly sandy loam 3 inches thick. Hard granite is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Rogert soil is moderately rapid. 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 moderate.

Rock outcrop consists of exposures of hard granite and highly weathered granite saprolite.

The Amesmont soil is moderately deep and well drained. It formed in colluvium and alluvium derived dominantly from granite. Typically the surface is 20 percent covered with fine gravel. The surface layer is

brown sandy loam 4 inches thick. The upper part of the subsoil is brown gravelly sandy clay loam 14 inches thick. The lower 6 inches are yellowish brown very gravelly sandy loam. The substratum is strong brown very gravelly loamy sand 12 inches thick. Weakly consolidated granite is at a depth of 36 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Amesmont soil is moderate. Available water capacity is very 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. Winter winds deposit additional snow on this soil.

This unit is used as rangeland, for wildlife habitat, and for recreation.

The potential plant community on the Rogert and Amesmont soils is mainly bluebunch wheatgrass, slimstem muhly, and threetip sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock and the steepness of slope. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the rock fragments on the surface of the soils, the hazard of water erosion, and the amount of Rock outcrop in the unit.

The Rogert soil is in capability subclass VIe, nonirrigated. Rock outcrop is in capability subclass VIIs. The Amesmont soil is in capability subclass VIe, nonirrigated. The Rogert and Amesmont soils are in the Shallow Igneous, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

221—Rohonda fine sandy loam, 3 to 6 percent slopes.

This moderately deep, well drained soil is on strath terraces and structural benches. It formed in residuum

derived from interbedded sandstone, limestone, and shale. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Joemre fine sandy loam, Thermopolis fine sandy loam, and Wycolo sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is brown fine sandy loam 3 inches thick. The upper part of the subsoil is strong brown sandy loam about 12 inches thick. The lower part is reddish yellow sandy loam 16 inches thick. Fractured reddish sandstone is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Rohonda 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 slight. The hazard of wind erosion is severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Rohonda soil is needleandthread, thickspike wheatgrass, Indian ricegrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, sagebrush, rabbitbrush, and forbs increase. As the range condition further deteriorates, annuals, forbs, and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the depth to bedrock and the potential for seepage. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

222—Rohonda-Tieside complex, 3 to 10 percent slopes.

This map unit is on structural benches, strath terraces, and hillslopes. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Rohonda fine sandy loam and 35 percent Tieside gravelly 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 Joemre fine sandy loam, Pilotpeak cobbly fine sandy loam, and Wycolo sandy loam. Also included are small Rock outcrops of limestone and sandstone. Included areas make up about 15 percent of the total acreage.

The Rohonda soil is moderately deep and well drained. It formed in alluvium and residuum derived dominantly from interbedded sandstone and limestone. Typically the surface layer is reddish brown fine sandy loam 6 inches thick. The upper part of the subsoil is reddish brown fine sandy loam 15 inches thick. The lower part is light red fine sandy loam 17 inches thick. Weakly consolidated sandstone is at a depth of 38 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Rohonda soil is moderately rapid. 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 severe.

The Tieside soil is shallow and well drained. It formed in weathered materials derived dominantly from interbedded sandstone, shale, and limestone. Typically the surface layer is reddish brown gravelly sandy loam 5 inches thick. The upper 5 inches of the subsoil are reddish brown sandy loam. The lower 3 inches are light reddish brown sandy loam. Weakly consolidated red sandstone is at a depth of 13 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Tieside soil is moderately rapid. 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 moderate.

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

The potential plant community on the Rohonda soil is needleandthread, thickspike wheatgrass, Indian ricegrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Tieside soil is mainly bluebunch wheatgrass, Indian ricegrass, mutton bluegrass, threadleaf sedge, and needleandthread. As the range condition deteriorates, shorter species of grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Rohonda soil is moderately limited by the low annual precipitation. Production on the Tieside soil is limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazards of wind and water erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If practical, tillage should be along the contour of the slope.

The Rohonda soil is in capability subclass IVe, nonirrigated. The Tieside soil is in capability subclass VII, nonirrigated. The Rohonda soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. The Tieside soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar

range sites in the 15- to 17-inch precipitation Southern Plains zone.

223—Rohonda-Cheadle-Rock outcrop association, 6 to 45 percent slopes.

This map unit is on ridges and escarpments and in adjacent swales. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 9,000 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 50 percent Rohonda fine sandy loam, 20 percent Cheadle very cobbly fine sandy loam, and 15 percent Rock outcrop. The Rohonda soil occurs on foot slopes of ridges and in swales with slopes of 6 to 15 percent. The Cheadle soil occurs on ridges and escarpments with slopes of 15 to 45 percent.

Included in this unit are small areas of Lymanson loam and a soil similar to the Rohonda soil, but with a darker surface layer or less clay in the subsoil. Also included are small areas of soils similar to the Cheadle soil, but with a lighter colored surface layer, redder colors, or weakly consolidated bedrock. Included areas make up about 15 percent of the total acreage.

The Rohonda soil is moderately deep and well drained. It formed in residuum and alluvium derived from sandstone. Typically the surface layer is reddish brown fine sandy loam 7 inches thick. The upper part of the subsoil is light brown very fine sandy loam 14 inches thick. The next part is pinkish gray fine sandy loam 3 inches thick. The lower part is light brown fine sandy loam 9 inches thick. Weakly consolidated fine-grained sandstone is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Rohonda soil is moderately rapid. Available water capacity is low. 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 severe.

The Cheadle soil is shallow and well drained. It formed in residuum and colluvium derived from sandstone. Typically the surface is 10 percent covered with sandstone flags and 20 percent covered with sandstone cobbles. The surface layer is brown very cobbly fine sandy loam 7 inches thick. The underlying material is yellowish brown very cobbly loamy fine sand 5 inches thick. Hard brown sandstone is at a depth of 12 inches. Depth to bedrock ranges from 10 to 20 inches. This soil is outside the characteristics of the Cheadle series because it does not have a horizon which contains an

accumulation of calcium carbonate. This difference, however, does not significantly affect the use or management of this soil.

Permeability of the Cheadle soil is moderately rapid. 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 slight.

Rock outcrop consists of exposures of hard sandstone.

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

The potential plant community on the Rohonda soil is mainly bluebunch wheatgrass, Parry danthonia, and Griffith wheatgrass. As the range condition deteriorates, bluegrasses, threetip sagebrush, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Cheadle soil is mainly bluebunch wheatgrass, spike fescue, and mountainmahogany. As the range condition deteriorates, threadleaf sedge and juniper increase. As the range condition further deteriorates, broom snakeweed, cheatgrass, and annual forbs invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,150 pounds in favorable years to 550 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope. The depth to bedrock is also a limitation to the development of stockwater ponds.

The Rohonda soil is in capability subclass IVe, nonirrigated. The Cheadle soil is in capability subclass VIIe, nonirrigated. The Rock outcrop is in capability subclass VIIIs. The Rohonda soil is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Cheadle soil is in the Rocky Hills, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

224—Ryark loamy sand, 1 to 6 percent slopes.

This very deep, well drained soil on is alluvial fans. It formed in eolian deposits derived from various sources. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Cushool sandy loam, Fiveoh sandy loam, Luhon loam, Rock River sandy loam, and a very deep soil similar to the Ryark soil, but which has a less pronounced subsoil. Also included is a soil similar to the Ryark soil, but which has limestone bedrock at a depth of 30 to 60 inches. Included areas make up about 15 percent of the total acreage.

Typically the surface layer is brown loamy sand 3 inches thick. The upper part of the subsoil is dark yellowish brown sandy loam 17 inches thick. The lower 16 inches are brown sandy loam. The substratum to a depth of 60 inches or more is light brown loamy sand. In some areas, the surface layer is sandy loam.

Permeability of the Ryark 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.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is needleandthread, thickspike wheatgrass, Indian ricegrass, threadleaf sedge, and silver sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and cheatgrass invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is poorly suited for mechanical range renovation and moderately suited for range seeding. The main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range

renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. In addition, it may not be economically feasible due to the coarse texture of the surface layer. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

225—Shirleybasin-Twocabin-Lahtida complex, 0 to 15 percent slopes.

This map unit is on dissected pediments to the Laramie Range. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Shirleybasin loam, 0 to 6 percent slopes; 25 percent Twocabin gravelly loam, 6 to 15 percent slopes; and 25 percent Lahtida loam, 2 to 12 percent slopes. The Shirleybasin soil is on the foot slopes of pediment breaks and on broad pediment summits. The Twocabin soil is on the crest of interfluvial ridges, pediment breaks, and convex knobs. The Lahtida soil is on the back slopes and foot slopes of the interfluvial ridges and pediment breaks. 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 Chalkville loam, Rock River sandy loam, and Ryark loamy sand. Also included are very small areas of Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Shirleybasin soil is very deep and well drained. It formed in alluvium and residuum derived dominantly from tuffaceous sedimentary rocks. Typically the surface layer is pale brown loam 2 inches thick. The upper part of the subsoil is brown sandy clay loam 6 inches thick. The next part is brown clay loam 19 inches thick. The next part to a depth of 52 inches are white clay loam. The lower part is light gray gravelly sandy clay loam to a depth of 60 inches or more.

Permeability of the Shirleybasin 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.

The Twocabin soil is very deep and well drained. It formed in alluvium overlying residuum derived from interbedded tuff, shale, and claystone. The surface layer is pale brown gravelly loam 4 inches thick. The upper part of the subsoil is brown very gravelly sandy clay loam 7 inches thick. The next 9 inches are very pale brown very gravelly loam. The lower part is white and very pale brown loam to a depth of 60 inches or more. The lower subsoil layer has a high amount of calcium carbonate.

Permeability of the Twocabin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for some plants; for others it is only 20 to 40 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

The Lahtida soil is moderately deep and well drained. It formed in alluvium overlying residuum derived from tuffaceous claystone. Typically the surface is 25 percent covered with gravel and cobbles. The surface layer is pale brown loam 2 inches thick. The upper part of the subsoil is yellowish brown clay loam 13 inches thick. The lower part is yellowish brown loam 13 inches thick. Weakly consolidated claystone is at a depth of 28 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Lahtida 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 mainly as rangeland and for wildlife habitat. It is also used for recreation.

The potential plant community on the Shirleybasin and Lahtida soils is mainly western wheatgrass, needleandthread, bluebunch wheatgrass, and big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Twocabin soil is mainly bluebunch wheatgrass, western wheatgrass, needleandthread, mutton bluegrass, and black sagebrush. As the range condition deteriorates, threadleaf sedge and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion.

Production of vegetation suitable for livestock grazing on the Shirleybasin and Lahtida soils is moderately limited by the low annual precipitation. Production on the Twocabin soil is limited by the low annual precipitation and by the high content of calcium carbonate in the lower subsoil layers, which restrict root growth.

The Shirleybasin and Twocabin soils are moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Lahtida soil is poorly suited for stockwater ponds due to the depth to bedrock and the steepness of slope.

This unit is moderately suited for mechanical range renovation and range seeding; the main limitations are the hazard of water erosion, and the gravel on and in the surface layer of the soils. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of water erosion. Tillage should be along the contour of the slope.

This unit is in capability subclass IVe, nonirrigated. The Shirleybasin and Lahtida soils are in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Twocabin soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

226—Silas loam, 1 to 6 percent slopes.

This very deep, somewhat poorly drained soil is on outwash terraces. It formed in alluvium derived dominantly from granite sources. The native vegetation consists mainly of grasses and sedges. Elevation is 7,800 to 8,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

Included in this unit are many small areas of Borollic Cambothids soils. They are on mounds about 10 feet by 25 feet in size, with the long dimension parallel to the slope. Also included are small areas of Greyback very cobbly sandy loam and Vensora loam. Included areas make up about 25 percent of the total acreage.

Typically the upper 22 inches of the surface layer is gray loam. The next 10 inches are dark gray gravelly clay loam. The underlying material is light gray loam to a depth of 60 inches or more.

Permeability of the Silas soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for plants that tolerate a water table, but it is 30 to 54 inches for plants that cannot. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between depths of 2.5 and 4.5 feet from April through July. This soil is subject to a rare hazard of flooding.

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

If this unit is used for hay and pasture, the main limitation is the presence of many very gravelly mounds. In addition, the short growing season limits the types of hay that can be grown. Due to the droughtiness of the soil, these mounds are less productive than the surrounding areas of Silas soil. If the flood irrigation method is used, distribution of irrigation water will be difficult due to the undulating terrain. Use of sprinklers for irrigation will result in a more efficient use and more even distribution of the irrigation water, but may not be economically feasible.

Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Silas soil is mainly basin wildrye, slender wheatgrass, western wheatgrass, and tufted hairgrass. As the range condition deteriorates, sedges and willows increase. As the range condition further deteriorates, Kentucky bluegrass and annuals invade. The potential plant community produces about 4,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 4,500 pounds in favorable years to 3,300 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. This unit is well suited to the production of vegetation suitable for livestock grazing. The wetness of the soil, however, influences the types of plants available for livestock

grazing. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This soil is well suited for stockwater ponds. Pits dug sufficiently deeper than the level of the water table can provide water for livestock during the period when the water table is at its highest level. This soil is well suited for mechanical range renovation and range seeding.

This unit is in capability subclass VIw, nonirrigated and irrigated. It is in the Subirrigated, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

227—Silas, gravelly substratum-Vensora loams, 0 to 6 percent slopes.

This map unit is in mountain valleys. The native vegetation consists mainly of grasses, grass-like plants, and shrubs. Elevation is 7,800 to 9,500 feet. The annual precipitation is 15 to 19 inches. The annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

This unit is 55 percent Silas loam, gravelly substratum, 1 to 6 percent slopes; and 25 percent Vensora loam, 0 to 3 percent slopes. The Silas, gravelly substratum soil is on the edges of the valleys. The Vensora soil is in the center of the valleys. 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 Amesmont fine sandy loam, Cryaquolls soil, and sand and gravel deposits. Included areas make up about 20 percent of the total acreage.

The Silas soil is very deep and somewhat poorly drained. It formed in alluvium derived dominantly from granite. Typically the surface layer is dark grayish brown loam 22 inches thick. The upper part of the underlying material is yellowish brown gravelly sandy clay loam 20 inches thick. The lower part to a depth of 60 inches or more is yellowish brown very gravelly sandy loam stratified with layers of gravelly loamy sand.

Permeability of the Silas soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 30 to 54 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table fluctuates between depth of 2.5 and 4.5 feet from April through July.

The Vensora soil is very deep and poorly drained. It formed in alluvium derived dominantly from granite. Typically the upper part of the surface layer is very dark grayish brown loam 7 inches thick. The lower part is dark

gray loam 10 inches thick. The upper part of the underlying material is brown loam 13 inches thick. The lower part to a depth of 60 inches or more is yellowish brown very gravelly sandy clay loam stratified with thin layers of sandy loam and loam.

Permeability of the Vensora soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more for water-tolerant plants, but it is only 6 to 30 inches for plants that cannot tolerate a water table. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate. A seasonal high water table is at a depth of 0.5 to 2.5 feet from April through July. This soil is subject to a rare hazard of flooding.

This map unit is used for irrigated hay, as rangeland, and for wildlife habitat.

If this unit is used for hay and pasture, the main limitation is the wetness of the soils. In addition, the short growing season limits the types of hay that can be grown. Applications of irrigation water will require careful planning. Due to the high water table, proper application of irrigation water is necessary to avoid saturation. If the upper layers of this soil are saturated for long periods of time, sedges and rushes will become the dominant plants and other yields will be significantly lower. To avoid overirrigating, irrigation water should be applied only if the soil moisture in the rooting zone is less than 75 percent. Applications of irrigation water should be adjusted to the available water capacity of the soil and to the crop needs.

Fertilizer is needed to ensure optimum growth of grasses and legumes, and should be applied according to soil tests. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on the Silas soil is mainly basin wildrye, slender wheatgrass, western wheatgrass, and tufted hairgrass. As the range condition deteriorates, sedges and willows increase. As the range condition further deteriorates, Kentucky bluegrass and annuals invade. The potential plant community produces about 4,000 pounds of air-dry vegetation per acre in normal years. Production ranges from 4,500 pounds in favorable years to 3,300 pounds in unfavorable years.

The potential plant community on the Vensora soil is mainly tufted hairgrass, Nebraska sedge, slough sedge, and willows. As the range condition deteriorates, willows, sedges, and arrowgrass increase. As the range condition further deteriorates, annuals invade. The potential plant community produces about 5,500 pounds of air-dry vegetation per acre in normal years. Production ranges from 6,500 pounds in favorable years to 4,000 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less

preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be deferred until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The Silas soil is well suited to the production of vegetation suitable for livestock grazing. The wetness of the Silas soil, however, influences the types of plants available for livestock grazing. Production on the Vensora soil is limited by the wetness of the soil.

This unit is well suited for stockwater ponds. Pits dug sufficiently deeper than the level of the water table can provide water for livestock. Because the water table is at a more shallow depth in the Vensora soil, it is more suitable for pits than the Silas soil. The Silas soil is well suited for mechanical range renovation and range seeding. The Vensora soil is poorly suited for mechanical range renovation and range seeding; the main limitation is the wetness of the soil. Use of equipment on the Vensora soil is limited to the period of the year when the water table is at its deepest level. If range seedings are planned on the Vensora soil, plant species carefully selected because of the wetness of the soil.

This unit is in capability subclass VIw, irrigated and nonirrigated. The Silas soil is in the Subirrigated, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site. The Vensora soil is in the Wetland, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

228—Stunner sandy loam, 2 to 8 percent slopes.

This very deep, well drained soil is on fan terraces and in valleys. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the average frost-free period is 85 to 110 days.

Included in this unit are small areas of Forelle loam, Luhon loam, and Poposhia loam. Also included are small areas of Borollic Camborthids soils and playas that are intermittently ponded with water. Included areas make up about 40 percent of the total acreage.

Typically the surface layer is brown sandy loam 3 inches thick. The upper part of the subsoil is brown clay loam 9 inches thick. The next part is pale brown and very pale brown loam 14 inches thick. The lower part is pale brown sandy loam to a depth of 60 inches or more. The middle and lower subsoil layers contain a high amount of calcium carbonate.

Permeability of the Stunner soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for some plants, but for others it is only 15 to 25 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

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

The potential plant community on the Stunner soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush, rabbitbrush, and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the low annual precipitation and by the high amount of calcium carbonate in the lower subsoil layers, which limits root growth.

This soil is poorly suited for stockwater ponds due to the potential for seepage losses. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

229—Stunner-Borollic Camborthids complex, 2 to 5 percent slopes.

This map unit is on fan terraces with a mound-intermound pattern of microrelief. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Stunner sandy loam and 40 percent Borollic Camborthids soil. The Stunner soils are in intermound areas. The Borollic Camborthids soil is on micromounds. 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 Alcova sandy loam, Forelle loam, Poposhia sandy loam, and Rock River sandy loam. Included areas make up about 20 percent of the total acreage.

The Stunner soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown sandy loam 3 inches thick. The upper 10 inches of the subsoil are brown loam. The next 12 inches are light gray loam. The lower part is pale brown loam to a depth of 60 inches or more. The middle and lower subsoil layers contain a high amount of calcium carbonate.

Permeability of the Stunner soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for some plants, but for others it is 15 to 25 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Borollic Camborthids soil is very deep and well drained. It formed in alluvium modified by congeliturbation. These soils are highly variable from area to area; no single profile is typical. Commonly, the surface layer is light yellowish brown gravelly sandy loam or very gravelly sandy loam 1 inch thick. The upper part of the subsoil is commonly yellowish brown gravelly sandy loam or very gravelly sandy clay loam 9 inches thick. The lower part is commonly light yellowish brown gravelly sandy loam or very gravelly sandy loam 15 inches thick. The substratum is commonly light yellowish brown gravelly sandy loam or sandy loam to a depth of 60 inches or more.

Permeability of the Borollic Camborthids soil is moderate to moderately 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 slight.

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

The potential plant community on the Stunner soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush, rabbitbrush, and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Borollic Camborthids soil is mainly needleandthread, Indian ricegrass, thickspike wheatgrass, and spineless horsebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

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

Production of vegetation on the Stunner soil suitable for livestock grazing is limited by the low annual precipitation and by the high amount of calcium carbonate in the lower subsoil layers, which limits root growth. Production on the Borollic Camborthids soil is limited by the low annual precipitation and by the droughtiness of the soil.

The Stunner soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Borollic Camborthids soil is poorly suited for stockwater ponds due to the potential for seepage losses. The Stunner soil is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The Borollic Camborthids soil is poorly suited for mechanical range renovation and range seeding; the main limitations are the very gravelly surface layer and the droughtiness of the soil. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. The Stunner soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Borollic Camborthids soil is in the Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

230—Stunner-Tisworth-Blazon complex, 1 to 6 percent slopes.

This map unit is on fan terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,950

to 7,200 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Stunner fine sandy loam, 2 to 6 percent slopes; 25 percent Tisworth sandy loam, 0 to 5 percent slopes; and 15 percent Blazon loam, 1 to 6 percent slopes. The Stunner and Tisworth soils are on convex and planar areas. The Blazon soil is on convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bullock sandy loam, Forelle loam, and Rock River loam. Also included are small areas of a moderately deep soil similar to the Stunner soil. Included areas make up about 20 percent of the total acreage.

The Stunner soil is very deep and well drained. It formed in alluvium. Typically the surface is less than 5 percent covered with gravel. The surface layer is pale brown fine sandy loam 1 inch thick. The upper part of the subsoil is yellowish brown clay loam 9 inches thick. The next part is pale brown clay loam 22 inches thick. The lower part is light brownish gray and grayish brown sandy clay loam to a depth of 60 inches or more. The middle and lower subsoil layers contain a high amount of calcium carbonate.

Permeability of the Stunner soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Tisworth soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown sandy loam 4 inches thick. The upper part of the subsoil is pale brown sandy clay loam 3 inches thick. The next part is light yellowish brown clay loam 12 inches thick. The lower part is light yellowish brown sandy clay loam to a depth of 60 inches or more. The subsoil is strongly alkaline and moderately saline.

Permeability of the Tisworth soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants, but for other it is only 10 to 20 inches because the alkalinity and salinity of the soil restrict root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Blazon soil is very shallow or shallow and well drained. It formed in residuum derived dominantly from shale. Typically the surface is 5 to 15 percent covered with medium and fine igneous gravel. The surface layer is pale brown loam 2 inches thick. The underlying material is very pale brown clay loam 10 inches thick. Weakly consolidated

shale is at a depth of 12 inches. Depth to bedrock ranges from 8 to 20 inches.

Permeability of the Blazon 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 moderate.

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

The potential plant community on the Stunner soil is mainly western wheatgrass, birdfoot sagebrush, big sagebrush, needleandthread, bluebunch wheatgrass, and gardner saltbush. As the range condition deteriorates, birdfoot sage, prairie junegrass, and Sandberg bluegrass increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 700 pounds of air-dry vegetation per acre in normal years. Production ranges from 900 pounds in favorable years to 500 pounds in unfavorable years.

The potential plant community on the Tisworth soil is mainly western wheatgrass, bottlebrush squirreltail, gardner saltbush, birdfoot sagebrush, and Indian ricegrass. As the range condition deteriorates, birdfoot sagebrush increases. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

The potential plant community on the Blazon soil is mainly western wheatgrass, bluebunch wheatgrass, black sagebrush, and bottlebrush squirreltail. As the range condition deteriorates, shorter grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 250 pounds in unfavorable years.

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

Production of vegetation suitable for livestock grazing on the Stunner soil is limited by the high amount of calcium carbonate in the lower subsoil layers, which limits root growth. Production on the Tisworth soil is limited by the alkalinity and salinity of the soil. Production on the Blazon soil is limited by the droughtiness of the soil. In addition, the low annual precipitation influences the amount of forage available on this unit for livestock grazing.

The Stunner and Tisworth soils are moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Blazon soil is poorly suited for stockwater ponds due to the depth to bedrock.

The Stunner soil is moderately suited for range seeding. The main limitation is the hazard of wind erosion. The Tisworth and Blazon soils are poorly suited for range seeding. The main limitations are the salinity and alkalinity of the Tisworth soil and by the droughtiness of the Blazon soil. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation is not practical on most areas of this unit because of the amount of brush growing on the soils. It also may not be economically feasible due to the coarse texture of the surface layer. Brush control may be needed on those areas that have more brush than would be present in the potential plant community.

Adequate residue must be maintained on the surface of soil at all times until the range seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind. If range seedings are planned on the Tisworth soil, seeding rates should be increased and plant species carefully selected because of the salinity and alkalinity of the soil.

The Stunner soil is in capability subclass IVe, nonirrigated. The Tisworth soil is in capability subclass VIi, nonirrigated. The Blazon soil is in capability subclass VIIi, nonirrigated. The Stunner soil is in the Saline Loamy, 10- to 14-inch precipitation, High Plains Southeast range site; the Tisworth soil is in the Impervious Clay, 10- to 14-inch precipitation, High Plains Southeast range site; and the Blazon soil is in the Very Shallow, 10- to 14-inch precipitation, High Plains Southeast range site.

231—Stunner-Urban land complex, 0 to 6 percent slopes.

This map unit is on strath terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 60 percent Stunner sandy loam and 25 percent Urban land. 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 Forelle loam and Rock River sandy loam. Also included are small areas of Borollic Camborthids soils. Included areas make up about 15 percent of the total acreage.

The Stunner soil is very deep and well drained. It formed in alluvium. Typically the surface layer is brown sandy loam 3 inches thick. The upper part of the subsoil is brown clay loam 9 inches thick. The next part is pale brown and very pale brown loam 14 inches thick. The lower part is pale brown sandy loam to a depth of 60 inches or more. The middle and lower subsoil layers contain a high amount of calcium carbonate.

Permeability of the Stunner soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more for some plants, but for other it is only 15 to 25 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If the soil is used for urban development, the main limitation is the moderately restricted permeability. If a septic system is to be installed, the absorption lines should be installed in the more permeable lower subsoil layer.

The Stunner soil is in capability subclass IVe, nonirrigated.

232—Teeler very gravelly sandy loam, 5 to 40 percent slopes.

This very deep, well drained soil is on mountainsides and alluvial fans. It formed in alluvium and colluvium derived dominantly from schist and granite. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 8,900 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 38 to 40 degrees F, and the frost-free period is less than 60 days.

Included in this unit are small areas of Bowen gravelly sandy loam and a soil similar to the Teeler soil, but which has a very gravelly sandy loam subsoil. Included areas make up about 25 percent of the total acreage.

Typically the surface is 50 percent covered with cobbles and gravel. The surface layer is very dark grayish brown very gravelly sandy loam 6 inches thick. The upper 8 inches of the subsoil are dark brown very gravelly sandy clay loam. The next 12 inches are light olive brown very gravelly sandy loam. The lower part is light brownish gray very cobbly sandy loam to a depth of 60 inches or more. The lower subsoil layer contains a high amount of calcium carbonate. This soil is outside the characteristics of the Teeler series because the subsoil has a more yellow color.

This difference, however, does not significantly affect the use or management of this soil.

Permeability of the Teeler soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 15 to 25 inches because the high content of calcium carbonate restricts root growth. Runoff is rapid and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Teeler soil is mainly bluebunch wheatgrass, Griffith wheatgrass, and Parry danthonia. As the range condition deteriorates, Sandberg bluegrass, prairie junegrass, and threadleaf sedge increase. As the range condition further deteriorates, broom snakeweed, curlycup gumweed, and cheatgrass invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 800 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soil.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

This unit is in capability subclass VIe, nonirrigated. It is in the Shallow Loamy, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

233—Thiel-Lymanon-Leavitt complex, 5 to 20 percent slopes.

This map unit is on dissected fan terraces and hills. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,800 to 8,200 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 38 to 40 degrees F, and the average frost-free period is less than 60 days.

This unit is 40 percent Thiel gravelly sandy loam, 35 percent Lymanon sandy loam, and 10 percent Leavitt 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 a soil similar to the Thiel soil but is not calcareous and a soil similar to the Lymanon soil but is more than 40 inches deep to bedrock. Included areas make up about 15 percent of the total acreage.

The Thiel soil is very deep and well drained. It formed in alluvium. Typically the surface is about 25 percent covered with gravel. The surface layer is brown gravelly sandy loam 3 inches thick. The upper 9 inches of the subsoil are brown and dark yellowish brown very gravelly sandy clay loam. The next 7 inches are very pale brown very gravelly sandy loam. The lower part is very pale brown extremely gravelly loamy sand to a depth of 60 inches or more. The middle and lower subsoil layers contain a high amount of calcium carbonate.

Permeability of the Thiel soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more for some plants, but for others it is 15 to 25 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

The Lymanson soil is moderately deep and well drained. It formed in alluvium derived dominantly from sandstone and tuffaceous siltstone. Typically the upper part of the surface layer is brown sandy loam 3 inches thick. The lower part is brown gravelly sandy loam 7 inches thick. The upper 8 inches of the subsoil are brown gravelly sandy clay loam. The lower part is white very gravelly loam 15 inches thick. Weakly consolidated sandstone bedrock is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches. This Lymanson soil is outside the characteristics of the Lymanson series because it has a very gravelly loam lower subsoil. This difference, however, does not significantly affect the use or management of this soil for the purposes of this survey.

Permeability of the Lymanson soil is moderate. Available water capacity is very 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 Leavitt soil is very deep and well drained. It formed in alluvium. Typically the surface is 20 percent covered with gravel. The surface layer is brown and grayish brown sandy loam 14 inches thick. The upper 8 inches of the subsoil are light brown clay loam. The next part is light yellowish brown sandy clay loam 14 inches thick. The lower part is very pale brown sandy clay loam to a depth of 60 inches or more.

Permeability of the Leavitt 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 mainly as rangeland and for wildlife habitat.

The potential plant community on the Thiel and Lymanson soils is mainly bluebunch wheatgrass, mutton bluegrass, needleandthread, black sagebrush, and

western wheatgrass. As the range condition deteriorates, junegrass, blue grama, and rabbitbrush increase. As the range condition further deteriorates, mustard larkspur, cheatgrass, and other annuals invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Leavitt soil is mainly western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush, rabbitbrush, and blue grama increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Thiel and Lymanson soils is moderately limited by the droughtiness of the soils and by the low annual precipitation. Production on the Leavitt soil is moderately limited by the low annual precipitation.

This unit is poorly suited for stockwater ponds. The main limitation is the steepness of slope. The potential for seepage losses in the Thiel soil and the depth to bedrock in the Lymanson soil are also limitations.

This unit is poorly suited for range seeding. The main limitations are the hazards of wind and water erosion. Mechanical range renovation is not practical in most areas because of the amount of sagebrush growing on the soils. Brush control may be needed in areas that are growing more sagebrush than would be present in the potential plant community.

This unit is in capability subclass VIe, nonirrigated. The Thiel and Lymanson soils are in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Leavitt soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

234—Tieside-Pilotpeak-Rock outcrop complex, 3 to 10 percent slopes.

This map unit is on cuesta dip slopes and structural benches. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature

is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 35 percent Tieside sandy loam, 35 percent Pilotpeak cobbly fine sandy loam, and 15 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 Alcova sandy loam, Rohonda fine sandy loam, and Wycolo sandy loam. Included areas make up about 15 percent of the total acreage.

The Tieside soil is shallow and well drained. It formed in residuum derived from interbedded limestone, sandstone, and shale. Typically the surface layer is yellowish red sandy loam 4 inches thick. The upper part of the subsoil is yellowish red sandy loam 9 inches thick. The lower part is reddish brown sandy loam 6 inches thick. Weakly consolidated interbedded sandstone, limestone, and shale are at a depth of 19 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Tieside soil is moderately rapid. 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 severe.

The Pilotpeak soil is very shallow or shallow and well drained. It formed in residuum and colluvium derived dominantly from limestone. Typically the surface is 60 percent covered with gravel and channers. The surface layer is brown cobbly fine sandy loam 1 inch thick. The upper part of the subsoil is dark brown very channery fine sandy loam 4 inches thick. The lower 6 inches are strong brown extremely channery fine sandy loam. Hard limestone is at a depth of 11 inches. Depth to bedrock ranges from 7 to 20 inches.

Permeability of the Pilotpeak soil is moderately rapid. 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.

Rock outcrop consists of exposures of limestone and sandstone.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Tieside soil is mainly bluebunch wheatgrass, Indian ricegrass, threadleaf sedge, mutton bluegrass, and needleandthread. As the range condition deteriorates, threadleaf sedge and shrubs increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Pilotpeak soil is mainly bluebunch wheatgrass, needleandthread, western

wheatgrass, and mountainmahogany. As the range condition deteriorates, threadleaf sedge and rabbitbrush increase. As the range condition further deteriorates, broom snakeweed, cactus, and cheatgrass invade. The potential plant community produces about 600 pounds of air-dry vegetation per acre in normal years. Production ranges from 800 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the soils and by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the cobbles on the surface of the Pilotpeak soil and the presence of Rock outcrop in the unit. In addition, range renovation is not practical in many areas due to amount of brush growing on the soil. It also may not be economically feasible due to the droughtiness of the soils.

The Tieside and Pilotpeak soils are in capability subclass VIIs, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Tieside soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site. The Pilotpeak soil is in the Rocky Hills, 10- to 14-inch precipitation, High Plains Southeast range site.

235—Tismid sandy loam, 0 to 5 percent slopes.

This very deep, well drained soil is on fan terraces. It formed in alluvium. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,900 to 7,050 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Twocabin very cobbly sandy clay loam, Forelle loam, and Stunner loam. Also included is a soil similar to the Tismid soil, but which is more yellow, calcareous in the surface layer, and has weakly consolidated shale at a depth of 30 to 50 inches. Included areas make up about 25 percent of the total acreage.

Typically the surface is 5 percent covered with gravel. The surface layer is pale brown sandy loam 4 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam 10 inches thick. The next part is very strongly alkaline very pale brown sandy clay loam 13 inches thick.

The lower part is pale brown loam to a depth of 60 inches or more.

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

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

The potential plant community on this unit is mainly western wheatgrass, bottlebrush squirreltail, birdfoot sagebrush, gardner saltbush, bottlebrush squirreltail, and Indian ricegrass. As the range condition deteriorates, birdfoot sagebrush increases. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is limited by the alkalinity of the soil and by the low annual precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Livestock grazing also should be managed to protect the unit from excessive erosion.

This soil is well suited for stockwater ponds. It is poorly suited for mechanical range renovation and range seeding; the main limitation is the alkalinity of the soil. The low annual precipitation should also be of concern when planning range seedings. Range renovation may not be practical in many areas because of the amount of brush growing on the soil. It also may not be economically feasible due to the alkalinity of the soil. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the alkalinity of the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

This unit is in capability subclass VI_s, nonirrigated. It is in the Impervious Clay, 10- to 14-inch precipitation, High Plains Southeast range site.

236—Tisworth-Gerdrum Family loams, 1 to 8 percent slopes.

This map unit is on stream terraces and fan terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual

precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Tisworth loam and 30 percent Gerdrum Family 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 Diamondville fine sandy loam, Forelle loam, and Stylite fine sandy loam. Also included is a soil similar to the Tisworth soil, but with gypsum in the lower subsoil. Included areas make up about 25 percent of the total acreage.

The Tisworth soil is very deep and well drained. It formed in alkaline alluvium. Typically the surface layer is dark yellowish brown loam 5 inches thick. The upper 10 inches of the subsoil are yellowish brown clay loam. The next 5 inches are light gray loam. The lower part to a depth of 60 inches or more is very pale brown sandy clay loam. The subsoil is moderately saline and strongly alkaline.

Permeability of the Tisworth soil is 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.

The Gerdrum Family soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown loam 1 inch thick. The upper part of the subsoil is strongly alkaline yellowish brown clay loam 15 inches thick. The next 21 inches are moderately saline yellowish brown clay loam. The lower part is moderately saline brown clay to a depth of 60 inches or more.

Permeability of the Gerdrum Family soil is very 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 as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and gardner saltbush. As the range condition deteriorates, shrubs increase. As the range condition further deteriorates, annual forbs invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 650 pounds in favorable years to 300 pounds in unfavorable years. Areas of this unit near Iron Mountain have a slightly higher production due to the higher precipitation.

The production of vegetation suitable for livestock grazing is limited by the salinity and alkalinity of the soils. If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing.

The Tisworth soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Gerdrum soil is well suited for stockwater ponds. This unit is poorly suited for mechanical range renovation and range seeding; the main limitations are the salinity and alkalinity of the soils. The low annual precipitation should also be of concern when planning range seedings. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity and alkalinity of the soils.

This unit is in capability subclass VIs, nonirrigated. It is in the Saline Upland, 10- to 14-inch precipitation, High Plains Southeast range site.

237—Tisworth-Gerdrum Family complex, 0 to 6 percent slopes.

This unit is on fan terraces and stream terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,800 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Tisworth sandy clay loam and 40 percent Gerdrum Family 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 Abston loam, Bullock sandy loam, Elkol silty clay loam, Forelle fine sandy loam, and Pinelli clay loam. Included areas make up about 15 percent of the total acreage.

The Tisworth soil is very deep and well drained. It formed in alluvium. Typically the surface layer is strongly alkaline light yellowish brown sandy clay loam 2 inches thick. The upper part of the subsoil is very strongly alkaline yellowish brown clay loam 11 inches thick. The next 25 inches are very strongly alkaline light yellowish brown clay loam. The lower part is strongly alkaline light yellowish brown clay loam to a depth of 60 inches or more.

Permeability of the Tisworth soil is 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.

The Gerdrum Family soil is very deep and well drained. It formed in alluvium. Typically the surface layer is pale brown sandy loam 2 inches thick. The upper part of the subsoil is very strongly alkaline yellowish brown clay 15 inches thick. The next 19 inches are strongly alkaline yellowish brown clay loam. The lower part is moderately saline light yellowish brown silty clay loam to a depth of 60 inches or more.

Permeability of the Gerdrum Family soil is very 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 severe.

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

The potential plant community on this unit is mainly western wheatgrass, bluebunch wheatgrass, needleandthread, gardner saltbush, big sagebrush, and birdfoot sagebrush. As the range condition deteriorates, blue grama, birdfoot sagebrush, and saltbush increase. As the range condition further deteriorates, foxtail barley and annual grasses and weeds invade. The potential plant community produces about 700 pounds of air-dry vegetation per acre in normal years. Production ranges from 900 pounds in favorable years to 500 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by the salinity and alkalinity of the soils. If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Grazing also should be managed to protect the unit from excessive erosion.

The Tisworth soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. The Gerdrum soil is well suited for stockwater ponds. This unit is poorly suited for mechanical range renovation and range seeding; the main limitations are the salinity and alkalinity of the soils. The low annual precipitation should also be of concern when planning range seedings. If range seedings are planned, seeding rates should be increased and plant species carefully selected because of the salinity and alkalinity of the soils.

This unit is in capability subclass VIs, nonirrigated. It is in the Saline Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Included in this unit is up to

25 percent Impervious Clay, 10- to 14-inch precipitation, High Plains Southeast range site.

238—Tule-Chalkville loams, 0 to 15 percent slopes.

This map unit is on ridges and pediments. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,600 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Tule loam and 30 percent Chalkville 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 Cutback fine sandy loam and Lahtida loam. Also included are small areas of tuff and tuffaceous sandstone Rock outcrop. Included areas make up about 20 percent of the total acreage.

The Tule soil is very shallow or shallow and well drained. It formed in alluvium and residuum derived dominantly from tuffaceous rock. Typically the surface layer is brown loam 3 inches thick. The upper part of the underlying material is yellowish brown loam 9 inches thick. The lower part is yellowish brown extremely gravelly loam 3 inches thick. Hard white tuff is at a depth of 15 inches. Depth to bedrock ranges from 4 to 20 inches.

Permeability of the Tule soil is moderate. 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 Chalkville soil is very shallow or shallow and well drained. It formed in alluvium and residuum derived dominantly from tuff. Typically the surface layer is pale brown loam 2 inches thick. The subsoil is yellowish brown clay loam 10 inches thick. The substratum is yellowish brown extremely gravelly sandy clay loam 3 inches thick. Hard tuff is at a depth of 15 inches. Depth to bedrock ranges from 9 to 20 inches.

Permeability of the Chalkville soil is moderate. Available water capacity is very low. Effective rooting depth is 9 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 mainly as rangeland and for wildlife habitat.

The potential plant community on the Tule soil is mainly bluebunch wheatgrass, bottlebrush squirreltail, and western wheatgrass. As the range condition deteriorates, black sagebrush and threadleaf sedge increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant

community produces about 450 pounds of air-dry vegetation per acre in normal years. Production ranges from 600 pounds in favorable years to 250 pounds in unfavorable years.

The potential plant community on the Chalkville soil is mainly bluebunch wheatgrass, western wheatgrass, and black sagebrush. As the range condition deteriorates, shorter grasses, sedges, and black sagebrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the low annual precipitation and by the droughtiness of the soils.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is poorly suited for mechanical range renovation and range seeding; the main limitations are the droughtiness of the soils and the hazard of water erosion.

This unit is in capability subclass VII_s, nonirrigated. The Tule soil is in the Very Shallow, 10- to 14-inch precipitation, High Plains Southeast range site. The Chalkville soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

239—Tyzak-Rock outcrop complex, 30 to 60 percent slopes.

This map unit is on mountain hogback slopes and canyon sides. The native vegetation consists mainly of shrubs and grasses. Elevation is 6,500 to 7,500 feet. The annual precipitation is 15 to 19 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 60 percent Tyzak cobbly very fine 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 Byrnie sandy loam, Canwall fine sandy loam, and Pilotpeak cobbly very fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Tyzak soil is very shallow or shallow and well drained. It formed in colluvium and residuum derived from limestone. Typically the surface is 60 percent covered with cobbles. The surface layer is brown cobbly very fine sandy

loam 4 inches thick. The subsoil is dark grayish brown very cobbly loam 9 inches thick. Hard limestone is at a depth of 13 inches. Depth to bedrock ranges from 6 to 20 inches.

Permeability of the Tyzak soil is moderate. 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 moderate.

Rock outcrop consists of exposures of limestone and hard sandstone.

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

The potential plant community on the Tyzak soil is mainly bluebunch wheatgrass, needleandthread, mountainmahogany, antelope bitterbrush, and spike fescue. As the range condition deteriorates, threadleaf sedge and juniper increase. As the range condition further deteriorates, broom snakeweed, cactus, and annual grasses and forbs invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,150 pounds in favorable years to 550 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing is limited by the droughtiness of the Tyzak soil and by the amount of Rock outcrop in the unit. Steepness of the slope limits access by livestock.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Tyzak soil is in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Tyzak soil is in the Rocky Hills, 15- to 19-inch precipitation, Foothills and Mountains Southeast range site.

240—Wycolo sandy loam, 3 to 6 percent slopes.

This moderately deep, well drained soil is on terraces and structural benches. It formed in residuum derived dominantly from interbedded sandstone and shale. The native vegetation consists mainly of grasses. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

Included in this unit are small areas of Almy loam, Rohonda sandy loam, and Thermopolis fine sandy loam. Included areas make up about 20 percent of the total acreage.

Typically the surface layer is brown sandy loam 3 inches thick. The upper part of the subsoil is strong brown and light brown sandy clay loam 13 inches thick. The lower part is strong brown sandy clay loam 24 inches thick. Weakly consolidated red shale is at a depth of 40 inches. Depth to bedrock ranges from 20 to 40 inches. The lower subsoil layer has a high amount of calcium carbonate.

Permeability of the Wycolo soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate in the lower subsoil restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Wycolo soil is western wheatgrass, needleandthread, big sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

This soil is poorly suited for stockwater ponds due to the depth to bedrock. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community. To reduce the hazard of wind erosion, adequate residue must be maintained on the surface of soil at all times until the seeding is established. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

241—Wycolo-Alcova complex, 3 to 10 percent slopes.

This map unit is on terraces with a mound-intermound pattern of microrelief. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 45 percent Wycolo fine sandy loam and 35 percent Alcova gravelly sandy loam. The Wycolo soil is on toe slopes of mounds and in intermound areas. The Alcova soil is on mounds. 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 Joemre fine sandy loam, Pilotpeak cobbly fine sandy loam, Rohonda fine sandy loam, and Tieside sandy loam. Included areas make up about 20 percent of the total acreage.

The Wycolo soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded red sandstone and shale. Typically the surface layer is light brown and reddish brown fine sandy loam 6 inches thick. The upper part of the subsoil is brown sandy clay loam 6 inches thick. The next part is pink loam and clay loam 13 inches thick. The lower part is light reddish brown clay loam 11 inches thick. Weakly consolidated red gypsiferous shale is at a depth of 36 inches. Depth to bedrock ranges from 20 to 40 inches. The middle and lower subsoil layers have a high amount of calcium carbonate.

Permeability of the Wycolo soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more for some plants, but for others it is only 12 to 24 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Alcova soil is very deep and well drained. It formed in alluvium overlying residuum derived from redbed sandstone. Typically the surface is 25 percent covered with granitic gravel. The surface layer is brown gravelly sandy loam 4 inches thick. The upper part of the subsoil is strong brown gravelly sandy clay loam 20 inches thick. The lower part is reddish yellow very gravelly sandy clay loam to a depth of 60 inches or more.

Permeability of the Alcova soil is moderate. 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 as rangeland and for wildlife habitat.

The potential plant community on this unit is western wheatgrass, needleandthread, bluebunch wheatgrass,

and big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Production of vegetation suitable for livestock grazing is moderately limited by the low annual precipitation.

The Wycolo soil is poorly suited for stockwater ponds due to the depth to bedrock. The Alcova soil is moderately well suited for stockwater ponds; the moderate potential for seepage losses is the main limitation. This unit is moderately suited for mechanical range renovation and range seeding; the main limitations are the gravel in the surface layer of the Alcova soil and the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

Adequate residue must be maintained on the surface of soil at all times until the seeding is established to reduce the hazard of wind erosion. Areas tilled for seeding must remain narrow and at right angles to the wind.

This unit is in capability subclass IVe, nonirrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

242—Wycolo-Alcova-Urban land complex, 3 to 6 percent slopes.

This map unit is on terraces. The native vegetation consists mainly of grasses and shrubs. Elevation is 7,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 30 percent Wycolo fine sandy loam, 25 percent Alcova gravelly sandy loam, and 25 percent Urban land.

Included in this unit are small areas of Joemre fine sandy loam, Pilotpeak cobbly fine sandy loam, Rohonda fine sandy loam, and Tieside sandy loam. Included areas make up about 20 percent of the total acreage.

The Wycolo soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded sandstone and shale. Typically the surface layer is light brown fine sandy loam 6 inches thick. The upper part of the subsoil is brown sandy clay loam 6 inches thick. The next part is pink loam and clay loam 14 inches thick. The lower part is light reddish brown clay loam 10 inches thick. Weakly consolidated red shale is at a depth of 36 inches. Depth to bedrock ranges from 20 to 40 inches. The middle and lower subsoil layers have a high amount of calcium carbonate.

Permeability of the Wycolo soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches for some plants, but for others it is only 12 to 24 inches because the high content of calcium carbonate restricts root growth. Runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

The Alcova soil is very deep and well drained. It formed in alluvium overlying residuum derived from redbed sandstone. Typically the surface is 25 percent covered with granitic gravel. The surface layer is brown gravelly sandy loam 4 inches thick. The upper part of the subsoil is strong brown gravelly sandy clay loam 20 inches thick. The lower part is reddish yellow very gravelly sandy clay loam to a depth of 60 inches or more.

Permeability of the Alcova 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.

Urban land is covered with buildings, streets, and parking lots. The original soil is either altered, removed, or buried with fill. Soil material under or immediately adjacent to structures may have been hauled to the site. Red fine sandy loam fill material is common in the city of Laramie.

This unit is used for urban development.

If the Wycolo soil is used for urban development, the main limitations are the shrink-swell potential and the depth to bedrock. If the Alcova soil is used for urban development, the main limitation is the moderately restricted permeability. Septic tank absorption fields buried in the bedrock underlying the Wycolo soil do not function properly. The Alcova soil is better suited for septic tank absorption fields, but the size of the field should be large enough to overcome the moderately restricted permeability. Excavations deeper than 20 to 40 inches in areas of the Wycolo soil are somewhat difficult because of the underlying bedrock. Paved roads and foundations of buildings should be designed to offset the effects of the shrinking and swelling of the Wycolo soil.

The Wycolo and Alcova soils are in capability subclass I_{ve}, nonirrigated.

243—Wycolo-Tieside sandy loams, 3 to 10 percent slopes.

This map unit is on structural benches, terraces, and on hills. The native vegetation consists mainly of grasses and shrubs. Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 50 percent Wycolo sandy loam and 35 percent Tieside 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 Alcova sandy loam, Pilotpeak cobbly fine sandy loam, and Rohonda fine sandy loam. Also included are small areas of soils similar to the Wycolo soil, but with a clay loam subsoil or a thinner subsoil. Included areas make up about 15 percent of the total acreage.

The Wycolo soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded sandstone and shale. Typically the surface layer is brown sandy loam 2 inches thick. The upper part of the subsoil is dark reddish brown sandy clay loam 9 inches thick. The lower part is reddish brown sandy clay loam 20 inches thick. Weakly consolidated red sandstone is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches. The lower subsoil layer has a high amount of calcium carbonate.

Permeability of the Wycolo soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Tieside soil is shallow and well drained. It formed in residuum derived dominantly from interbedded sandstone, shale, and limestone. Typically the surface is 10 percent covered with cobbles. The surface layer is yellowish red sandy loam 1 inch thick. The upper part of the subsoil is yellowish red sandy loam 5 inches thick. The lower part is light reddish brown sandy loam 8 inches thick. Weakly consolidated red sandstone is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Tieside soil is moderately rapid. Available water capacity is very low. Effective rooting depth is only 10 to 20 inches. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Wycolo soil is western wheatgrass, needleandthread, bluebunch

wheatgrass, and big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Tieside soil is mainly bluebunch wheatgrass, Indian ricegrass, threadleaf sedge, mutton bluegrass, and needleandthread. As the range condition deteriorates, threadleaf sedge and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation on the Wycolo soil suitable for livestock grazing is moderately limited by the low annual precipitation. Production on the Tieside soil is limited by the droughtiness of the soil and by the low annual precipitation.

This unit is poorly suited for stockwater ponds due to the depth to bedrock. It is moderately suited for mechanical range renovation and range seeding; the main limitation is the hazard of wind erosion. The low annual precipitation should also be of concern when planning range seedings. Mechanical range renovation may not be practical in many areas because of the amount of sagebrush growing on the soil. In addition, it may not be economically feasible on the Tieside soil due to the droughtiness of that soil. Brush control may be needed in areas that are growing more brush than would be present in the potential plant community.

The Wycolo soil is in capability subclass IVe, nonirrigated. The Tieside soil is in capability subclass VII, nonirrigated. The Wycolo soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Tieside soil is in the Shallow Sandy, 10- to 14-inch precipitation, High Plains Southeast range site.

244—Wycolo-Thermopolis-Rock outcrop complex, 10 to 50 percent slopes.

This map unit is on cuesta escarpments. The native vegetation consists mainly of grasses and shrubs.

Elevation is 6,000 to 7,800 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 40 to 45 degrees F, and the frost-free period is 85 to 110 days.

This unit is 40 percent Wycolo fine sandy loam, 10 to 20 percent slopes; 30 percent Thermopolis fine sandy loam, 20 to 50 percent slopes; and 10 percent Rock outcrop. The Wycolo soil is on the foot slopes of escarpments and in concave areas. The Thermopolis soil and the Rock outcrop are on the shoulder and back slopes of escarpments. 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 Byrnie sandy loam, Joemre fine sandy loam, and Rohonda fine sandy loam. Included areas make up about 20 percent of the total acreage.

The Wycolo soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded sandstone and shale. Typically the surface layer is yellowish red fine sandy loam 3 inches thick. The upper part of the subsoil is yellowish red sandy clay loam 10 inches thick. The lower part is reddish yellow and yellowish red sandy clay loam 11 inches thick. Weakly consolidated red shale is at a depth of 24 inches. Depth to bedrock ranges from 20 to 40 inches. A small amount of gypsum is present in the subsoil. The lower subsoil layer has a high amount of calcium carbonate.

Permeability of the Wycolo soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more for some plants, but for others it is only 10 to 20 inches because the high content of calcium carbonate restricts root growth. Runoff is medium and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

The Thermopolis soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from siltstone and shale. Typically the surface is 25 percent covered with limestone and sandstone gravel. The surface layer is reddish brown fine sandy loam 2 inches thick. The upper 3 inches of the subsoil are yellowish red loam. The lower 9 inches are red silt loam. Weakly consolidated red shale is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Thermopolis 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 severe. The hazard of wind erosion is severe.

Rock outcrop consists of exposures of red shale, sandstone, and limestone.

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

The potential plant community on the Wycolo soil is mainly western wheatgrass, needleandthread, big

sagebrush, and bluebunch wheatgrass. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Thermopolis soil is mainly bluebunch wheatgrass, needleandthread, mutton bluegrass, black sagebrush, and western wheatgrass. As the range condition deteriorates, shorter grasses and shrubs increase. As the range condition further deteriorates, annual forbs and grasses invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

If the range is overgrazed, the proportion of preferred forage plants decreases while the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community; it also should be managed to protect the unit from excessive erosion. Production of vegetation suitable for livestock grazing on the Wycolo soil is moderately limited by the low annual precipitation. Production on the Thermopolis soil is limited by the droughtiness of the soil and by the low annual precipitation.

This unit is poorly suited for stockwater ponds, mechanical range renovation, and range seeding due to the steepness of slope.

The Wycolo soil is in capability subclass VIe, nonirrigated. The Thermopolis soil is in capability subclass VIIe, nonirrigated. Rock outcrop is in capability subclass VIIIs. The Wycolo soil is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. The Thermopolis soil is in the Shallow Loamy, 10- to 14-inch precipitation, High Plains Southeast range site. Areas of this map unit near Iron Mountain are in similar range sites in the 15- to 17-inch precipitation, Southern Plains zone.

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 to prevent 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 for 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 recreational 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. The system of land capability classification (Murray, 1974) used by the Natural Resources Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources 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 high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of barnyard manure and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the

way they respond to management. The criteria used in grouping do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include 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, or for engineering purposes.

In the capability system, soils are generally grouped at three levels— capability class, subclass, and unit. 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 hazard is the 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 capability class or subclass of each soil is shown in table 5 and is also given in the section “Detailed Soil Map Units.”

Water Quality in Agriculture

The potential for impacting the quality of surface or ground water should be considered in the planning and management of all agricultural operations. The potential for impacting water quality exists whenever pesticides, fertilizers and manures are used in proximity to surface waters or aquifers. Removal of these materials from the application site by surface water runoff and soil leaching is the main hazard.

Impairment by Pesticides

Water quality impairment can occur if pesticides are leached below the root zone or enter a water body attached to suspended sediment or in solution of runoff waters. The potential for loss of pesticides by surface water runoff or leaching is a combined function of soil and pesticide properties, climate factors, kind of crop, and application method.

To minimize the potential for surface or ground water quality impairment by pesticides, the use of a pest management system is recommended. Pest management systems target infestations of weeds, insects, or disease. These systems reduce the adverse effects of pest infestations to plant growth and crop production while minimizing adverse effects to environmental resources. These systems utilize the most appropriate measures or combinations of measures for pest control, including biological, cultural and chemical, and include environmental effects, health hazards, and economic benefits. Field scouting and economic thresholds are used to determine if pesticides should be used and the time of application. Only necessary and properly timed applications of pesticides are utilized.

In a pest management system, the time of application is chosen with consideration of the soil moisture condition, anticipated weather condition, and irrigation schedules. Proper timing of applications reduces the potential for loss by leaching or surface water runoff. Erosion-control practices are used to minimize soil loss, surface water runoff, and the transport of adsorbed or dissolved pesticides to surface waters.

Characteristics of pesticides, such as solubility, toxicity, degradation, and absorption, are considered in pesticide selection. Soil, geology, depth to water table, proximity to surface water, topography, and climate are site characteristics which affect pesticide transport. This information on pesticide properties and site characteristics is considered when pesticides are

selected to minimize the potential for impairment of the quality of surface and ground water.

In table 6, the soils in the survey area have been rated for their relative potential for pesticide loss through leaching and surface water runoff. These ratings and the information on pesticide properties, climate, kind of crop, and application method are used to determine the potential for water-quality impairment.

The soil leaching and surface loss potential ratings given in table 6 were developed from information on soil parameters. These ratings represent the relative capacity of a soil to retain a pesticide at the point of application, regardless of management or climatic inputs. The properties of pesticides, climatic factors, kind of crop, and application method were not considered in the development of these ratings.

The soil properties and features used in the development of the ratings for potential pesticide loss through soil leaching are those that affect the infiltration rate, permeability, and the pesticide attenuation capacity. These soil properties are soil texture, surface layer thickness, organic matter content, structure, bulk density, permeability of soil or bedrock, shrink-swell potential, depth to bedrock, depth to a water table, and slope. Infiltration rate is interpreted from the hydrologic soil group and slope.

The soil properties and features considered in the ratings for potential pesticide loss to surface water runoff are those that affect rates of runoff and erosion. They include soil texture, organic matter content, structure, particle-size distribution, permeability, restricting layers, soil depth, depth to water table, flooding, slope and shrink-swell potential.

A rating of *slight* indicates a slight probability for loss of pesticides if pesticides with very small, small or medium loss potentials are used. A rating of *moderate* indicates a slight probability for loss of pesticides if pesticides with very small or small loss potentials are used, and a moderate probability of pesticide loss if pesticides with a medium or large potential for loss are used. A rating of *severe* indicates a moderate probability for loss of pesticides if pesticides with very small or small loss potentials are used, and a high probability of pesticide loss if pesticides with a medium or large potential for loss are used.

In these ratings, the pesticide is considered to have been applied to bare soil by either surface or aerial methods. If the pesticide is applied to a field of a growing crop or weeds, the potential for pesticide loss will be lower. Information on pesticide properties can be obtained for the local office of the Natural Resources Conservation Service or Extension Service or from pesticide dealers.

If the possibility for pesticide loss by soil leaching or surface water runoff is identified, an onsite evaluation is

usually necessary to determine the potential impacts on water quality. If water quality will be affected, the land user should consider alternative pesticides, alternative management practices, alternative application methods, or cultural or biological pest-control methods to reduce the potential of pesticide loss.

Impairment by Nutrients

An adequate and timely supply of nutrients is necessary for maximum crop production. It is important that nutrients added to the soil are efficiently used because nutrient amounts in excess of crop needs can result in pollution. Nutrient management consists of measures that minimize the amount of nutrients available for potential impairment of the quality of surface and ground water while providing an optimum amount for crop production. The rate of fertilizer application is important in minimizing the losses through leaching and surface water runoff. The amount of fertilizer applied should be based on a realistic yield goal. A proper balance of essential nutrients and soil moisture is necessary. A deficiency of one element may reduce the use of other nutrients by the crop. The nutrients which have not been used by the crop are available for offsite transport. Soil tests are an important guide to the proper use of fertilizers. These tests, combined with information about soil type, previous cropping history, and anticipated soil moisture level, should be used to estimate fertilizer requirements. Use of crops which require a small amount of nitrogen, such as legumes, in rotation with crops that require a large amount of nitrogen reduces the potential for nutrient loss. Use of ammonium nitrogen fertilizers, such as anhydrous ammonia, can be used can help reduce nitrate leaching. If practical, all fertilizer should be incorporated into the soil to reduce the loss by volatilization and surface water runoff.

Proper timing of fertilizer applications can be effective in reducing the potential losses of nutrients. Nitrogen should be applied as closely to the plant demand periods as possible. Split applications of nitrogen, especially on sandy soils, helps to reduce leaching losses. Apply half of the requirement at planting time and the other half at the critical growth stage of the crop.

Irrigation water management is very effective in reducing the amount of nitrogen leached from irrigated fields. Irrigation efficiency must be high at all times to reduce the amount of leaching caused by deep percolation.

Use practices for erosion and runoff control reduces the amount of nitrogen or phosphorus transported to surface waters. Maintaining adequate amounts of crop residue on the surface and good soil tillth increases water infiltration and reduces the potential for nutrient loss by surface water runoff.

Rangeland

Robert E. Baumgartner, Range Conservationist, Natural Resources Conservation Service, assisted in the preparation of this section.

Rangeland is land on which the potential plant community is predominantly native grasses, grass-like plants, forbs, and shrubs suitable for grazing and browsing use. About 94 percent of the survey area is rangeland. The majority of ranch income is derived from livestock, principally cattle. Cow-calf operations dominate. Livestock estimates for the county in 1983 were for 54,000 cattle and 7,500 sheep (Wyoming Recreation Commission, 1976). Average ranch size is about 9,000 acres.

On many ranches the forage produced on rangeland is augmented by corn and protein supplements. In winter the native forage is supplemented by hay and protein concentrate. Creep feeding of calves and yearlings to increase market weight is done 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.

Table 7 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and

unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre 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.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. 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, control 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 important range management practices on all rangeland in the survey area are proper grazing use and planned grazing systems, which include deferred grazing and proper season of use in combination with good distribution of grazing. Distribution of grazing can be accomplished with proper placement of salt and watering facilities, combined with fencing where needed. The suitability of range improvement practices, such as brush management, range seeding, and renovation depends on the characteristics of the given site.

Windbreaks and Environmental Plantings

Richard Rintamaki, State Biologist, Natural Resources Conservation Service, assisted in the preparation of 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.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil and snow management objectives. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings, reduce building heating and cooling costs, and reduce noise. Tree and shrub plantings can also reduce wave action on ponds and harvest snow for stockwater, wildlife water, and irrigation water.

Tables 8a, 8b, and 8c show the height that selected adaptable trees and shrubs are expected to reach, given adequate care, in 20 years for each represented soil group and planting zone. The windbreak suitability grouping and planting zone designation for every soil in a detailed soil map unit is given in table 9. Definitions of the windbreak suitability groups and planting zones are given below. This information can be used as a guide in planning windbreaks and other tree and shrub plantings.

Adaptability for planting trees and shrubs in Wyoming was based on each plant species' tolerance for the minimum and maximum air temperatures, soil temperatures of an area, and data and observations collected from woody plant material trials and existing windbreaks.

Additional information on planning windbreaks and other environmental plantings as well as planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service, the Cooperative Extension Service, or from a commercial nursery.

The windbreak suitability groups in this survey area are described in the following paragraphs.

Windbreak suitability group 1.—The soils in this group are very deep or deep and somewhat poorly drained to well drained. They have loamy surface layers and subsoils, and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the pH is less than 7.9, the electrical conductivity is less than 2 millimhos per centimeter, and carbonates are generally absent, but never exceed 5 percent calcium

carbonate equivalent. Depth to a water table during the growing season is 3 to 5 feet, or the site receives beneficial moisture from surrounding landscapes or frequent flooding.

This group is well suited for windbreaks and environmental plantings. Planting may be delayed for a short period in spring because of wetness. The water table in the soils in this group provides moisture to the trees and shrubs once they have established roots to the depth of the water table.

Windbreak suitability group 1H.—The soils in this group are organic (peat) and moderately deep to very deep. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the pH is less than 7.9, and the electrical conductivity is less than 4 millimhos per centimeter. Depth to the water table during the growing season is 3 to 5 feet, or the site receives beneficial moisture from surrounding landscapes or frequent flooding.

This group is moderately well suited for windbreaks and environmental plantings. Planting may be delayed for a short period in spring because of wetness. Because these soils are dominantly composed of peat, special planting considerations are necessary. The water table in the soils of this group provides moisture to the trees and shrubs once they have established roots to that depth.

Windbreak suitability group 1KK.—The soils in this group are very deep or deep and somewhat poorly drained to well drained. They have loamy surface and subsoil layers and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the pH values range from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and carbonates range from 15 to 40 percent calcium carbonate equivalent. Depth to a water table during the growing season is 3 to 5 feet, or the site receives beneficial moisture from surrounding landscapes or frequent flooding.

This group is moderately suited for windbreaks and environmental plantings. Planting may be delayed for a short period in the spring because of wetness. The very high carbonates and high pH in the soil significantly limit the selection and rate of growth of trees and shrubs. The water table in the soils of this group provides moisture to the trees and shrubs once they have established roots to that depth.

Windbreak suitability group 1KW.—The soils in this group are very deep or deep and somewhat poorly drained to well drained. They have loamy surface and subsoil layers and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the pH values range from 7.9 to 8.4, the

electrical conductivity is less than 4 millimhos per centimeter, and carbonates range from 5 to 15 percent calcium carbonate equivalent. Depth to a water table during the growing season is 3 to 5 feet, or the site receives beneficial moisture from surrounding landscapes or frequent flooding.

This group is moderately well suited for windbreaks and environmental plantings. Planting may be delayed for a short period in the spring because of wetness. The amount of carbonates and high pH in the soil slightly limits the selection and rate of growth of trees and shrubs. The water table in the soils of this group provides moisture to the trees and shrubs once they have established roots to the depth of the water table.

Windbreak suitability group 2.—The soils in this group are very deep or deep, poorly drained to somewhat poorly drained, and excessively wet or ponded during the spring or overflow periods. These soils range from sandy to clayey. Rock fragments in the soil may range up to 60 percent by volume. Available water capacity of the soil is more than 2 inches. In the upper 12 inches of the soil the pH is less than 7.9, the electrical conductivity is less than 2 millimhos per centimeter, and carbonates are generally absent but never exceed 5 percent calcium carbonate equivalent. Depth to a water table during the growing season is 1.5 to 3 feet.

This group is moderately well suited for windbreaks and environmental plantings. Special planting considerations will be necessary because these soils are wet during the growing season. Wetness limits the rooting depth and survival of some species. The selection of trees and shrubs should be based on this limitation.

Windbreak suitability group 2H.—The soils in this group are organic (peat), very deep or deep, and poorly drained to somewhat poorly drained. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the calcium carbonate equivalent is less than 1 percent, the pH is less than 7.9, and the electrical conductivity is less than 2 millimhos per centimeter. Depth to a water table during the growing season is 1.5 to 3 feet.

This group is moderately suited for windbreaks and environmental plantings. Because these soils are wet and dominantly composed of peat, special planting considerations are necessary. Wetness limits the rooting depth and survival of some species. The selection of trees and shrubs should be based on this limitation.

Windbreak suitability group 2KK.—The soils in this group are very deep or deep, poorly drained to somewhat poorly drained, and excessively wet or ponded during the spring or overflow periods. These soils range from sandy to clayey. Rock fragments in the soil may range up to 60 percent by volume. Available water capacity of the soil is more than 2 inches. In the upper 12 inches of the soil the

pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and carbonates range from 15 to 40 percent calcium carbonate equivalent. Depth to a water table during the growing season is 1.5 to 3 feet.

This group is moderately suited for windbreaks and environmental plantings. Special planting considerations will be necessary because these soils are wet during the growing season. The very high amount of carbonates and high pH in the soil significantly limits the rate of growth of trees and shrubs. Wetness limits the rooting depth and survival of some species. The selection of trees and shrubs should be based on these limitations.

Windbreak suitability group 2KW.—The soils in this group are very deep or deep, poorly to somewhat poorly drained, and excessively wet or ponded during the spring or overflow periods. These soils range from sandy to clayey. Rock fragments in the soil may range up to 60 percent by volume. Available water capacity of the soil is more than 2 inches. In the upper 12 inches of the soil the pH values range from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and carbonates range from 5 to 15 percent calcium carbonate equivalent. Depth to a water table during the growing season is 1.5 to 3 feet.

This group is moderately suited for windbreaks and environmental plantings. Special planting considerations will be necessary because these soils are wet during the growing season. The amount of carbonates and high pH in the soil moderately limits the rate of growth of trees and shrubs. Wetness limits the rooting depth and survival of some species. The selection of trees and shrubs should be based on these limitations.

Windbreak suitability group 3.—The soils in this group are very deep or deep and moderately well to well drained. They have loamy surface and subsoil layers and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the pH is less than 7.9, the electrical conductivity is less than 2 millimhos per centimeter, and carbonates are generally absent, but never exceed 5 percent calcium carbonate equivalent. Depth to a water table during the growing season is more than 5 feet.

This group is well suited for windbreaks and environmental plantings.

Windbreak suitability group 4.—The soils in this group are moderately deep to very deep and moderately well drained to well drained. The upper 8 to 20 inches of the soil are loamy; below this depth the soils are clayey. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil to underlying bedrock is more than 5 inches. In the upper 12 inches of the soil the pH is less than 7.9, the electrical conductivity

is less than 2 millimhos per centimeter, and carbonates are generally absent, but never exceed 5 percent calcium carbonate equivalent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately well suited for windbreaks and environmental plantings. A high content of clay in the lower part of the soil moderately limits the selection and rate of growth of trees and shrubs. The droughtiness of the moderately deep soils in this group is also a limiting factor.

Windbreak suitability group 4C.—The soils in this group are moderately deep to very deep and moderately well drained to well drained. Typically these soils are clayey throughout. However, the upper 8 inches may be loamy. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 3.75 inches. In the upper 12 inches of the soil the pH is less than 7.9, the electrical conductivity is less than 2 millimhos per centimeter, and calcium carbonate equivalent does not exceed 5 percent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The high content of clay limits the selection and rate of growth of trees and shrubs. The droughtiness of the moderately deep soils in this group is also a limiting factor. Because of the high content of clay, extra care is need to ensure that the soil is firmly packed around the roots when trees and shrubs are planted.

Windbreak suitability group 4CK.—The soils in this group are moderately deep to very deep and moderately well drained to well drained. Typically these soils are clayey throughout. However, the upper 8 inches may be loamy. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 3.75 inches. In the upper 12 inches of the soil the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 5 to 15 percent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The high content of clay, high pH, and amount of carbonates moderately limit the selection and rate of growth of trees and shrubs. The droughtiness of the moderately deep soils in this group is also a limiting factor. Because of high content of clay, extra care is need to ensure that the soil is firmly packed around the roots when trees and shrubs are planted.

Windbreak suitability group 4K.—The soils in this group are moderately deep to very deep and moderately well drained to well drained. The upper 8 to 20 inches of the soil are loamy; below this depth the soils are clayey.

Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 5 inches. In the upper 12 inches of the soil the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and carbonates range from 5 to 15 percent calcium carbonate equivalent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The high content of clay in the lower part of the soil, the amount of carbonates, and the high pH moderately limit the selection and rate of growth of trees and shrubs. The droughtiness of the moderately deep soils in this group is also a limiting factor.

Windbreak suitability group 5.—The soils in this group are very deep or deep and moderately well drained to well drained. They have loamy surface and subsoil layers. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil ranges from 3.75 to 7.5 inches. In the upper 12 inches of soil, the pH is less than 7.9, the electrical conductivity is less than 2 millimhos per centimeter, and the calcium carbonate equivalent is less than 5 percent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately well suited for windbreaks and environmental plantings. The droughtiness of the soil moderately limits the selection and rate of growth of trees and shrubs.

Windbreak suitability group 5K.—The soils in this group are very deep or deep and moderately well drained to well drained. They have loamy surface and subsoil layers. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil ranges from 3.75 to 7.5 inches. In the upper 12 inches of soil the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and calcium carbonate equivalent ranges from 5 to 15 percent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The amount of carbonates, high pH, and droughtiness of the soil moderately limit the selection of trees and shrubs.

Windbreak suitability group 5KK.—The soils in this group are very deep or deep and moderately well drained to well drained. They have loamy surface and subsoil layers. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil ranges from 3.75 to 7.5 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 15 to 40

percent. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The very high amount of carbonates, high pH, and the droughtiness of the soil significantly limit the selection of trees and shrubs.

Windbreak suitability group 6.—The soils in this group are moderately deep over sand, gravel, and similar layers with a water permeability of more than 20 inches per hour or other layers restrictive to roots. These soils are well drained to excessively drained. The upper part of the soils are loamy, and may contain up to 60 percent rock fragments by volume. Available water holding capacity of the soil to underlying bedrock or other restrictive layers is 2.0 to 3.75 inches. In the upper 12 inches of soil, the pH is less than 7.9, the electrical conductivity is less than 2 millimhos per centimeter, and the calcium carbonate equivalent is less than 5 percent. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The droughtiness of the soil significantly limits the selection and rate of growth of trees and shrubs. Providing permanent supplemental water is recommended for successful establishment and growth of trees and shrubs.

Windbreak suitability group 6D.—The soils in this group are moderately deep over an impervious layer. They are well drained to excessively drained. They have loamy or clayey surface and subsoil layers. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of the soil the calcium carbonate equivalent is less than 5 percent, the pH is less than 7.9 and the electrical conductivity is less than 2 millimhos per centimeter. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The droughtiness of the soil moderately limits the selection and rate of growth of trees and shrubs.

Windbreak suitability group 6DK.—The soils in this group are moderately deep over an impervious layer. They are well drained to excessively drained. They have loamy or clayey surface and subsoil layers. Rock fragments throughout the soil may range to 60 percent by volume. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges

from 5 to 15 percent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The amount of carbonates, high pH, and the droughtiness of the soil moderately limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 6G.—The soils in this group are moderately deep over sand, gravel, and similar layers with a water permeability of more than 20 inches per hour. These soils are well drained to excessively drained. The surface and subsoil layers are loamy or clayey and may contain up to 60 percent rock fragments by volume. Available water holding capacity of the soil is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of the soil the calcium carbonate equivalent is less than 5 percent, the pH is less than 7.9, and the electrical conductivity is less than 2 millimhos per centimeter. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The droughtiness of the soil moderately limits the selection and rate of growth of trees and shrubs.

Windbreak suitability group 6GK.—The soils in this group are moderately deep over sand, gravel, and similar layers with a water permeability of more than 20 inches per hour. They are well drained to excessively drained. The surface and subsoil layers are loamy or clayey and may contain up to 60 percent rock fragments by volume. Available water holding capacity of the soil is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 5 to 15 percent. Depth to a water table during the growing season is more than 5 feet.

This group is moderately suited for windbreaks and environmental plantings. The amount of carbonates, high pH, and the droughtiness of the soil moderately limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 6GKK.—The soils in this group are moderately deep over sand, gravel, and similar layers with a water permeability of more than 20 inches per hour. They are well drained to excessively drained. The surface and subsoil layers are loamy or clayey and may contain up to 60 percent rock fragments by volume. Available water holding capacity of the soil is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 15 to 40 percent. Depth to a water table during the growing season is more than 5 feet

This group is poorly suited for windbreaks and environmental plantings. The very high amount of carbonates, high pH, and the droughtiness of the soil significantly limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 6K.—The soils in this group are moderately deep over sands, gravel, and similar layers with a water permeability of more than 20 inches per hour or other layers restrictive to roots. They are well drained to excessively drained. The surface and subsoil layers are loamy or clayey and may contain up to 60 percent rock fragments by volume. Available water holding capacity of the soil is 2.0 to 3.75 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 5 to 15 percent. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The amount of carbonates, high pH, and the droughtiness of the soil significantly limit the selection and rate of growth of trees and shrubs. Providing permanent supplemental water is recommended for successful establishment and growth of trees and shrubs.

Windbreak suitability group 6KK.—The soils in this group are moderately deep over sand, gravel, and similar layers with a water permeability of more than 20 inches per hour or other layers restrictive to roots. They are well drained to excessively drained. The surface and subsoil layers are loamy or clayey and may contain up to 60 percent rock fragments by volume. Available water holding capacity of the soil is 2.0 to 3.75 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is less than 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 15 to 40 percent. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The very high amount of carbonates, high pH, and the droughtiness of the soil significantly limit the selection and rate of growth of trees and shrubs. Providing permanent supplemental water is recommended for successful establishment and growth of trees and shrubs.

Windbreak suitability group 7.—The soils in this group are very deep or deep and well drained to excessively drained. These soils are sandy and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 2 inches but commonly less than 5 inches. In the upper 12 inches of the soil the calcium carbonate equivalent is less than 5 percent, the pH is less than 7.9, and the electrical conductivity is less than 2 millimhos per centimeter. Depth

to a water table during the growing season is more than 5 feet.

This group is poorly suited to windbreaks in areas where supplemental watering is not practical. The droughtiness of the soil significantly limits the selection and rate of growth of trees and shrubs. Providing permanent supplemental water is recommended for successful establishment and growth of trees and shrubs. Wind erosion at or near the planting site can adversely limit the health and vigor of young windbreaks. The sandy soil surface layer requires specialized site preparation, planting methods, and management to ensure successful tree and shrub plantings.

Windbreak suitability group 8.—The soils in this group are very deep or deep and moderately well drained to well drained. They have loamy surface and subsoil layers and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of the soil the calcium carbonate equivalent is 5 to 15 percent, the pH is 7.9 to 8.4, and the electrical conductivity is up to 4 millimhos per centimeter. Depth to a water table during the growing season is more than 5 feet.

This group is moderately well suited for windbreaks and environmental plantings. The amount of carbonates and high pH in the soil slightly limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 8K.—The soils in this group are very deep or deep and moderately well drained to well drained. They have loamy surface and subsoil layers and have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil is more than 7.5 inches. In the upper 12 inches of soil, the pH ranges from 7.9 to 8.4, the electrical conductivity is up to 4 millimhos per centimeter, and the calcium carbonate equivalent ranges from 15 to 40 percent. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The very high amount of carbonates and high pH in the soil significantly limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 9C.—The soils in this group are moderately deep to very deep and moderately well drained to well drained. Typically, these soils are clayey and have less than 35 percent rock fragments by volume throughout. However, the upper 8 inches be loamy. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of the soil the electrical conductivity ranges from 4 to 16 millimhos per centimeter. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The high pH and low to moderate

salinity in the soil significantly limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 9L.—The soils in this group are moderately deep to very deep and moderately well drained to well drained. They have loamy surface layers. The subsoil is loamy or clayey. If the subsoil is clayey, the soil has a loamy surface layer 8 inches or more thick. These soils have less than 35 percent rock fragments by volume throughout. Available water capacity of the soil to underlying bedrock or other restrictive layers is more than 3.75 inches but commonly less than 7.5 inches. In the upper 12 inches of the soil the electrical conductivity ranges from 4 to 16 millimhos per centimeter. Depth to a water table during the growing season is more than 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The high pH and low to moderate salinity in the soil significantly limit the selection and rate of growth of trees and shrubs.

Windbreak suitability group 9W.—The soils in this group are poorly drained to moderately well drained and moderately deep to very deep. These soils range from sandy to clayey. In the upper 12 inches of soil, the electrical conductivity ranges from 4 to 16 millimhos per centimeter. Depth to a water table during the growing season ranges from 1.5 to 5 feet.

This group is poorly suited for windbreaks and environmental plantings. The high pH and low to moderate salinity in the soil significantly limit the selection and rate of growth of trees and shrubs. Planting may be delayed for a short period in spring because of wetness.

Windbreak suitability group 10.—The soils in this group have one or more characteristics that are severely limiting to the planting and growth of trees and shrubs. Among these characteristics are: the soil depth is shallow; available water capacity of the soil to underlying bedrock or other restrictive layers is less than 2 inches; the calcium carbonate equivalent is more than 40 percent or the electrical conductivity is more than 16 millimhos per centimeter in the upper 12 inches of the soil; or a water table during the growing season is within 18 inches of the soil surface.

This group is not usually recommended for windbreaks and environmental plantings. However, onsite investigations may reveal that some tree and shrub plantings can be made with special treatments. The selection of species must be tailored to the soil conditions at the site.

The windbreak planting zones used in this survey area are described in the following paragraphs.

Planting Zone I includes areas of soils with a mean annual soil temperature from 47 degrees F to 59 degrees F.

Planting Zone II includes areas of soils with a mean annual soil temperature of less than 47 degrees F, a mean summer soil temperature of more than 59 degrees F, and precipitation of 10 to 14 inches. In the winter this zone is characterized by frequent periods of cold, dry winds and soil surfaces that are frequently blown free of snow.

Planting Zone III includes areas of soils with a mean annual soil temperature of less than 47 degrees F, a mean summer soil temperature of less than 59 degrees F, and precipitation of 15 or more inches. This zone is characterized by a snowpack throughout most of the winter.

Recreation

The soils of the survey area are rated in table 10 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 sewer lines. 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 recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, 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 a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in table 11 and interpretations for septic tank absorption fields in table 12.

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 influence wildlife populations primarily through the types of habitat produced. Studies dating back to the 1940's show wildlife productivity directly related to soil fertility. The abundant populations of wildlife encountered by early settlers and planners were found on the best soils in a given ecological zone. While it is true some species of wildlife can be produced on all soils, it is also generally true that wildlife productivity is a function of the biotic potential of the soil. The quantity and quality of most vegetative wildlife habitat elements will not exceed the capability of the soil resource, unless artificially supplied through intensive management systems.

Most wildlife habitat are created, improved, or maintained by planting suitable vegetation, manipulating existing vegetation, inducing natural establishment of desired plants, or by combinations of such measures. The behavior of soils can be predicted from knowledge of their properties. The growth habits and characteristics of plants that comprise wildlife habitat are affected by such behavior. From the appraisal of these vegetative habitat elements, the suitability of a site for various types of wildlife can be approximated.

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.

The descriptions of the general soil map units list the representative wildlife species known to occur in the general soil map unit. Wildlife habitat information was taken from the various maps and reports published by the Wyoming Game and Fish Department, other governmental agencies, and private companies.

Information is provided in this report on the capability of the soils to support irrigated and nonirrigated crops and native range plants. This report also includes windbreak and forestry interpretations. Information on the existing and potential plant communities will enable the user to select sites for habitat management. The user can determine the intensity of plant community management needed to produce satisfactory results.

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 for 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 should 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 or 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content;

soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or

maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to 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 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth

to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. 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.

Landfills must be able to bear heavy vehicular traffic. They involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect a landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 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 to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a 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 a 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 have a water table at a depth of 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. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, 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 and soil family 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 high 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 14 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; embankments, dikes, and levees; and aquifer-fed excavated ponds. 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 and irrigation.

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.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground- water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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 to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, 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 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series and soil family under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If 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 Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 15.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074

millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally 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 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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.

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 classes are

low, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent; and *very high*, greater than 9 percent.

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. Soils are grouped according to the following distinctions:

1. Coarse sands, 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 coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, 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 loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.
4. Clays, silty clays, noncalcareous 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. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. Crops can be grown if measures to control wind erosion are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can easily be grown if ordinary measures to control wind erosion are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils

are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of rock fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in 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 17 gives estimates of various soil 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 infiltration 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 very deep or 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 to very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after

rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 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, or 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. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding 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 little or no horizon development.

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 estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 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.

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.

A *Cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A *thin* pan is sufficiently thin that excavations can be made by backhoes or small rippers but not trenching machines. A *thick* pan is so thick or massive that blasting or special equipment is needed in 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 the 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 results in a severe hazard of corrosion. 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.

Table 18 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

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