United States
Department of
Agriculture

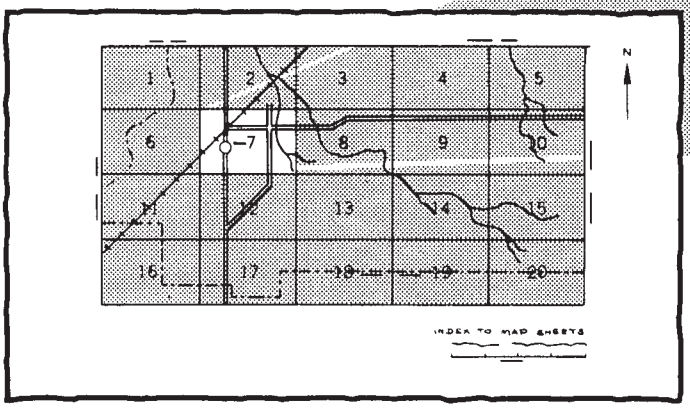
Soil
Conservation
Service

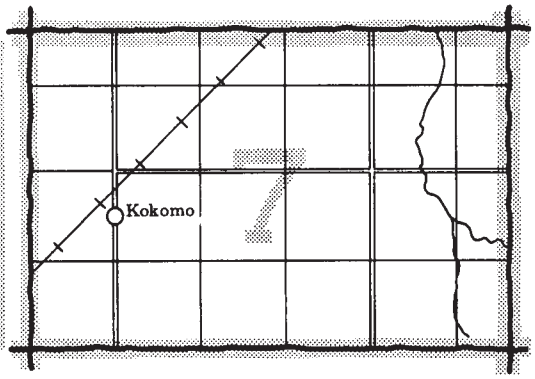
In cooperation with
United States Department
of the Interior,
Bureau of Indian Affairs,
and Montana Agricultural
Experiment Station
Montana State University,
State Land and
Investments Department

Soil Survey of Blaine County and part of Phillips County Montana

HOW TO USE

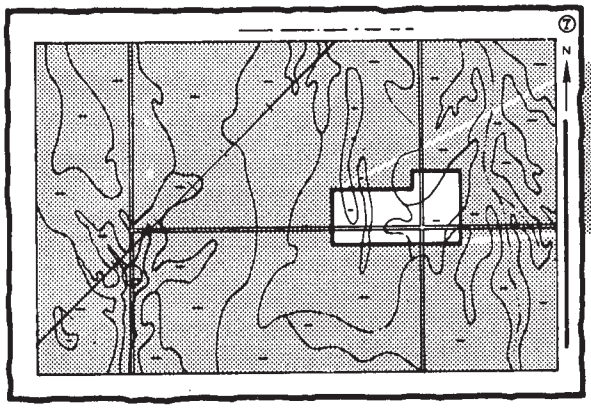
1. Locate your area of interest on the "Index to Map Sheets"

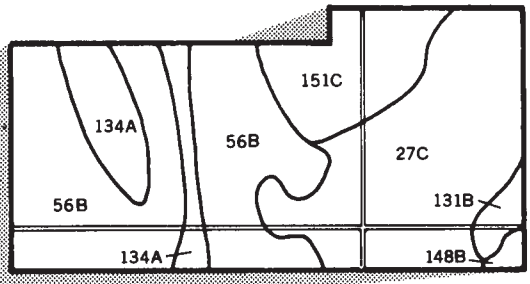




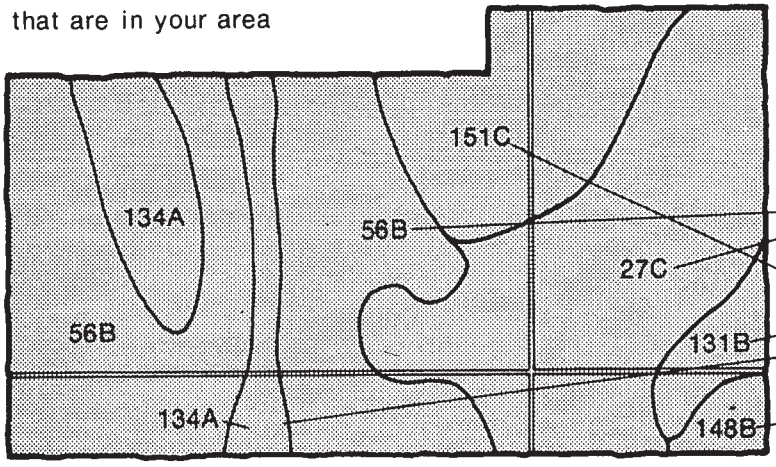
2. Note the number of the map sheet and turn to that sheet.

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





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



Symbols

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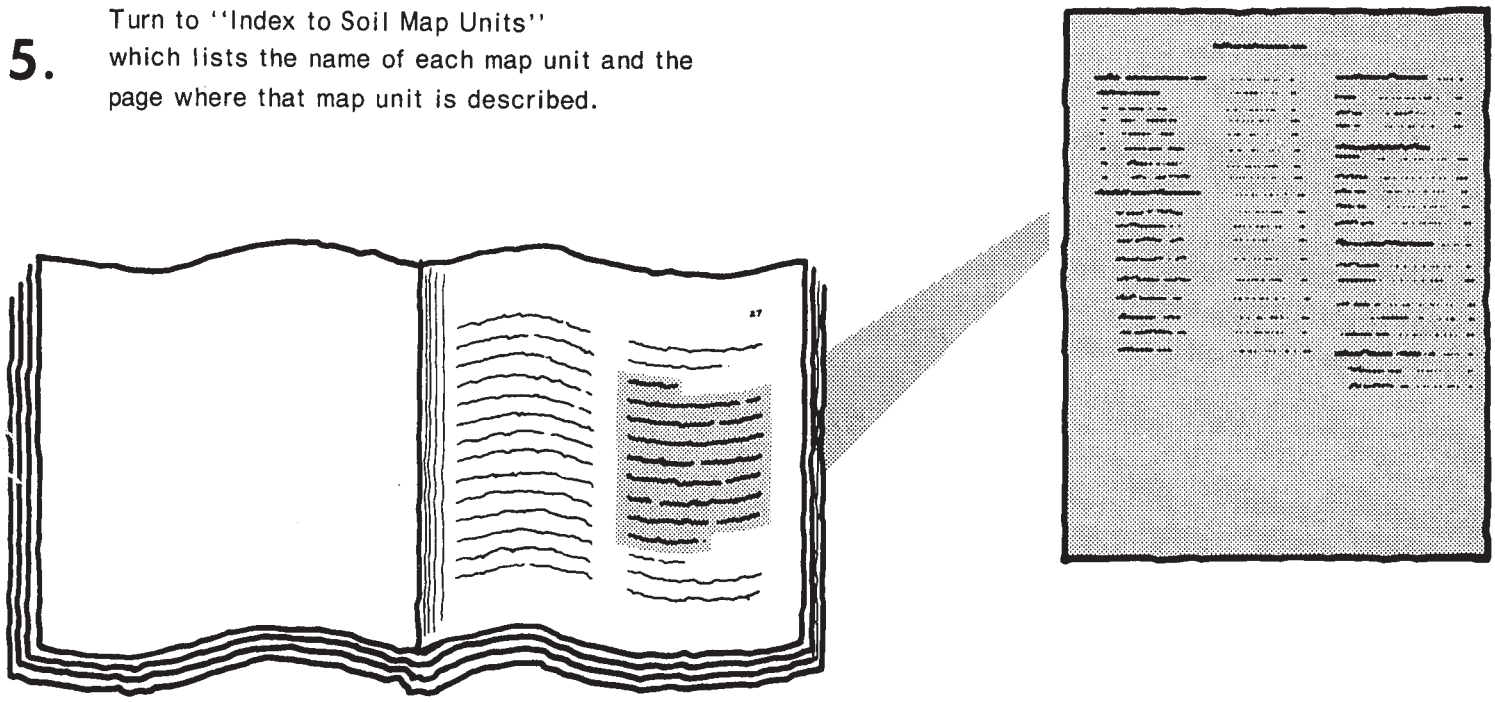
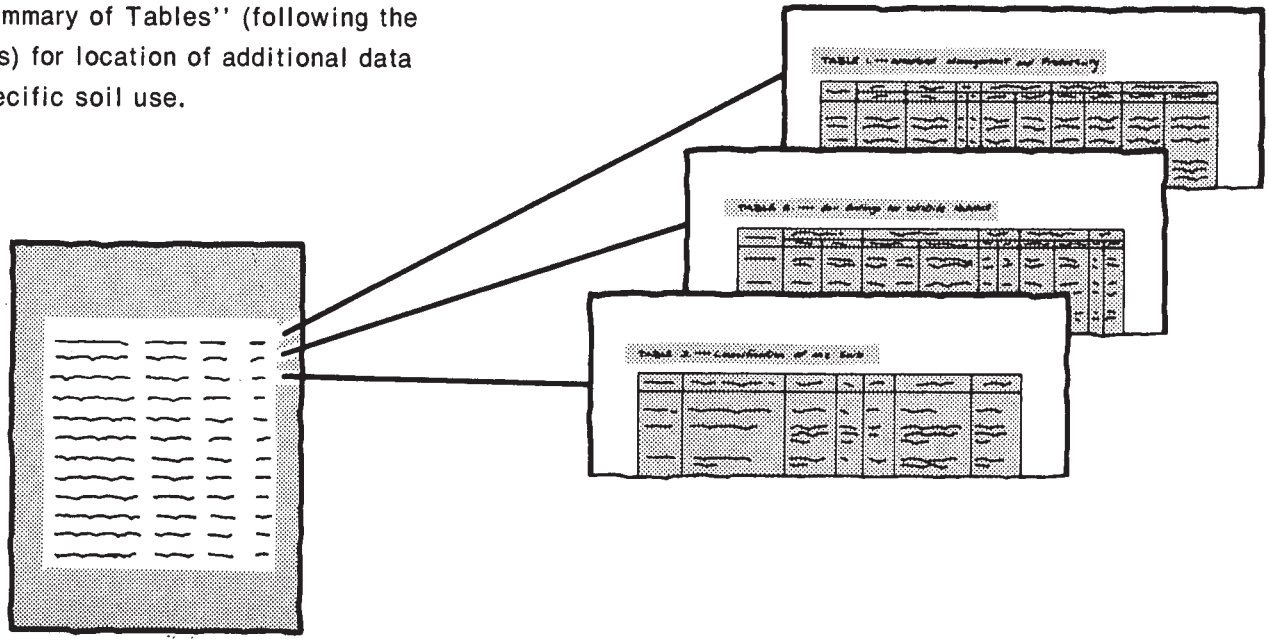
THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was completed in 1976. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service; the United States Department of the Interior, Bureau of Indian Affairs; and the Montana Agricultural Experiment Station, Montana State University, State Land and Investments Department. It is part of the technical assistance furnished to the Blaine County Conservation District and Fort Belknap Tribal Council.

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.

contents

soil series

Issued April 1986

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summary of tables

foreword

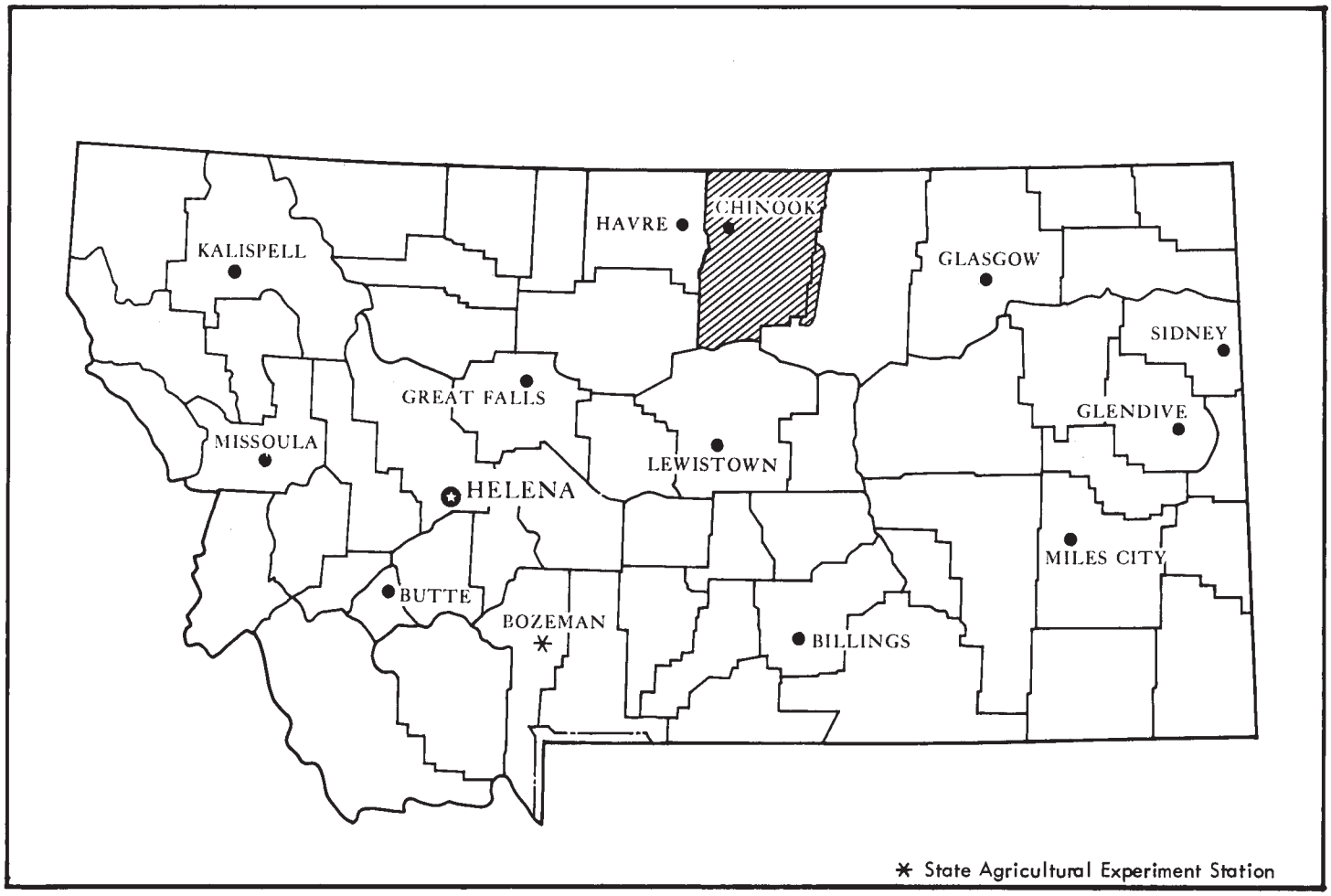
This soil survey contains information that can be used in land-planning programs in the survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact 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 insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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

Van K. Haderlie
State Conservationist
Soil Conservation Service



Location of Blaine County and part of Phillips County in Montana.

soil survey of
Blaine County and part of Phillips County, Montana

By George B. Hilts, Soil Conservation Service

Fieldwork by Arial Anderson, Huey A. Long, Robert E. Richardson, and LaMonte C. Bingham, Soil Conservation Service, and Thomas Quillen, Stanley B. Cline, and Donald E. McClure, Bureau of Indian Affairs

United States Department of Agriculture, Soil Conservation Service, and United States Department of the Interior, Bureau of Indian Affairs, in cooperation with the Montana Agricultural Experiment Station Montana State University, State Land and Investments Department

BLAINE COUNTY AND PART OF PHILLIPS COUNTY make up the survey area. The area is in the extreme north-central part of Montana. It is bounded on the north by the Province of Saskatchewan, Canada, on the west by Hill and Chouteau Counties, on the south by the Missouri River and Phillips County, and on the east by Phillips County. The area is made up of all of Blaine County, 2,730,880 acres, and part of Phillips County, 115,448 acres. The area covers about 4,447 square miles.

In the survey area, about 633,408 acres of land are owned by Indians, 536,085 acres are federally owned, 178,555 acres are state owned, and 1,498,280 acres are privately owned. The Fort Belknap Indian Reservation makes up most of the Indian owned land; Indian Trust land makes up a small acreage. The Indian lands are administered by the Fort Belknap Tribal Council and the Bureau of Indian Affairs.

general nature of the survey area

This section includes information about the history and population of the survey area, natural resources, climate, agriculture, and physiography.

history and population

The early inhabitants of the area were the Blackfeet and Gros Ventres Indians. Later, the Assiniboine Indians migrated into the area. Fur traders started coming into the area soon after the Lewis and Clark Expedition of 1804-06. The first successful trading post was Fort Belknap, which was established in the early 1870's on the Milk River near the present site of Chinook.

The original Fort Belknap Indian Reservation was established in 1873. It included a large area north of the Missouri River in northern Montana. Amendments to the Indian Reservation Act have reduced the reservation to its present size.

The gold rush days in western Montana brought many settlers into the survey area. Boats brought people and cargo up the Missouri River to Fort Benton in the late 1870's through the 1880's. During periods of low water, steamboats frequently were unloaded on Cow Island at a point where Cow Creek empties into the Missouri River. The Cow Island Trail was used to transport people and cargo overland to points further west.

The Milk River Valley was settled after the completion of the Northern Pacific Railroad in 1887. Cattle ranching expanded during the 1880's and 1890's, and raising cattle, sheep, and horses remained the major land use until 1908 when large tracts of public land were opened for settlement. Homesteading continued until 1917. Because of a drought from 1917 to 1919, some of the homesteaded land was abandoned. Many ranchers suffered severe livestock losses in the blizzard of 1919.

Farm and ranch populations declined further in the 1920's and 1930's. The drought and depression in the 1930's resulted in more land being abandoned or taken over by lending agencies and mortgage companies. Some of this land was purchased by neighboring farmers and ranchers, but thousands of acres went to county, state, and federal ownership. Most of the land held by lending agencies and by the county were taken over by private ownership or by the federal government.

Blaine County was established from a part of Chouteau County on March 2, 1912. At that time Blaine County included the western one-third of what is now Phillips County. Phillips County was established in 1915, and since then the boundaries of Blaine County have not changed.

The population of Blaine County in 1970 was 6,727, according to the U.S. Census, and that of Chinook, the county seat of Blaine County, was 1,813. Chinook is in the west-central part of the county in the Milk River Valley. Other centers of population are Harlem, Hays, Hogeland, Turner, Zurich, and Fort Belknap Agency.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Blaine and Phillips Counties are usually quite warm in summer. There are frequent spells of hot weather and occasional cool days. Winters are very cold because of the Arctic air masses that frequently move into the area. Most of the precipitation falls during the warm period and normally it is heaviest late in spring and early in summer. Snowfall normally is not heavy. The snow is blown into drifts so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Chinook and Cleveland in the period 1951 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter at Chinook, Montana, the average temperature is 17 degrees F, and the daily minimum temperature is 6 degrees. The lowest temperature on record, -50 degrees, occurred at Chinook on January 20, 1954. In summer the average temperature is 67 degrees, and the average daily maximum temperature is 83 degrees. The highest recorded temperature, 109 degrees, occurred on August 5, 1961.

In winter at Cleveland, Montana, the average temperature is 20 degrees F, and the average daily minimum temperature is 8 degrees. The lowest temperature on record, -41 degrees, occurred at Cleveland on January 24, 1969. In summer the average temperature is 65 degrees, and the average daily maximum temperature is 79 degrees. The highest recorded temperature, 107 degrees, occurred on August 5, 1961.

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

Of the total annual precipitation at Chinook, 9 inches, or 75 percent, generally falls from April through September, the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 7 inches. The heaviest 1-day rainfall during the period of record was 2.95 inches at Chinook on June 17, 1965.

Of the total annual precipitation at Cleveland, 12 inches, or 80 percent, usually falls from April through September, the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 9 inches. The heaviest 1-day rainfall during the period of record was 2.57 inches at Cleveland on June 13, 1970.

Thunderstorms in the survey area occur on about 22 days each year, and most occur in summer.

Average seasonal snowfall is 29 inches at Chinook and 55 inches at Cleveland. The greatest snow depth at any one time during the period of record was 29 inches at Chinook and 18 inches at Cleveland. On an average of 19 days, at least 1 inch of snow is on the ground at Chinook and at Cleveland, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 45 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 51 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in April.

Blizzards occur several times each winter in the survey area. Hail falls during summer thunderstorms in small scattered areas.

markets and transportation

Chinook and Harlem are the major shopping centers and markets within the area. Smaller towns or places such as Hays, Lodgepole, Turner, Cleveland, Lohman, Lloyd, Hodgeland, Zurich, and Fort Belknap Agency have limited services. Most of the grain produced in the area is transported by truck or rail to west coast markets. The livestock, mainly calves or yearlings, is shipped to feedlots in other areas.

The major roads in the survey area are U.S. Highway 2, which nearly parallels the railroad in an east-west direction; State Highway 376, extending from U.S. Highway 2 southeast of Harlem, southward across the Fort Belknap Reservation; and State Highway 241, which extends northeast from Harlem to Canada. A county network of gravel roads is extensive in the dry-farmed areas. There are only a few access roads in ranching areas. A bus line serves the area east and west on U.S. Highway 2.

Small airports with asphalt surfaced runways are located in the towns of Chinook and Harlem.

agriculture

Farms and ranches provide the economic base in the survey area. Agricultural income in most years is fairly well balanced between the production of livestock and cultivated crops.

About 79 percent, or 2,256,000 acres, of the area is rangeland and grazable woodland. The major income-producing livestock are cattle (cow-calf units), hogs, and sheep. Most livestock is shipped out of the area for finishing or processing.

About 19 percent of the area, or 550,000 acres, is used for cultivated crops, both irrigated (80,000 acres) and dryland (470,000 acres). The major dryland crops are wheat, barley, and hay. Wheat and barley are grown in a crop-fallow rotation. The major irrigated crops are wheat, barley, hay, and corn for silage.

The remaining 2 percent of the survey area, about 40,000 acres, is divided between commercial woodland, 18,000 acres, and nonagricultural land, 22,000 acres.

The major area of irrigated land is in the Milk River Valley and along the principal tributaries of the Milk River. The largest areas of dry cropland are on the "Big Flat" in the northeastern part of the survey area and on the rolling glaciated plains that lie south of the Milk River Valley. Most of the potential commercial woodland is in the Little Rocky Mountains; some small areas are in the Bearpaw Mountains.

A part of the Milk River Valley was organized into the Paradise Conservation District in 1944. Other areas in Blaine County were added to this district in 1957. In 1961 the district was reorganized into the Blaine County Soil Conservation District. It included all of the county except the part in the Fort Belknap Indian Reservation.

irrigated land

That part of the Milk River Valley that is within the survey area is the largest area under irrigation. It is served by five major gravity systems that divert water from the Milk River. Off-season water is stored in the Fresno Reservoir on the Milk River, about 12 miles west-northwest of Havre in Hill County. Additional water is diverted through a canal on the Swift Current Creek, a tributary of the St. Mary River, to the upper part of the Milk River. The water supply is sufficient in most years, but excessive use of water for irrigation, lack of good drainage, and canal losses have caused some areas to become seeped and saline.

Small but important areas along Battle, Lodge, Clear, Cow, Snake, Bean, Peoples, and Little Peoples Creeks are irrigated to produce hay and grain crops. Although these creeks are classified as perennial streams, the water supply is limited or is not available during part of the summer.

Storage dams or wells supply water to some sprinkler irrigation systems on uplands, and a large aquifer, which is recharged only from precipitation, supplies irrigation water to the "Big Flat" area.

ground water

The quality and quantity of ground water in the survey area depends largely on bedrock formations, which are exposed or underlie the superficial glacial and stream deposits. The glacial till on the glaciated plains, which varies from a few feet to about 200 feet in thickness, is generally not a dependable source of good quality ground water.

The dark colored shale of the Bearpaw Formation, which underlies a large part of the northern glaciated plains, is not a dependable source of highly mineralized water. Bearpaw shale also underlies the glaciated plains in a part of the Fort Belknap Reservation and is exposed in higher areas on the uplands in the southern part of the survey area.

Some sections of the soft shale and sandstone of the Judith River Formation, which underlies the Bearpaw Formation, produce moderate amounts of water that is generally suitable for domestic and livestock use. This formation underlies most of the southern glaciated plains west of the Fort Belknap Reservation. It also underlies extrusive igneous and colluvial deposits on slopes of the Bearpaw Mountains and Little Rocky Mountains, and it is exposed or underlies the Bearpaw formation in the southern part of the survey area.

Wells in the Milk Valley yield a small to moderate amount of highly mineralized water, except for shallow wells in sandy alluvium near the Milk River. Deep wells drilled several hundred feet through the alluvium into the Judith River Formation produce enough water for livestock use. This water is generally of poor quality, so water for household use is generally hauled from the towns of Chinook or Harlem.

Valleys of the larger tributaries of the Milk River and the Missouri River generally have gravelly alluvium that produces enough good water for domestic and livestock uses.

The "Big Flat" area has plenty of good quality ground water for domestic and livestock use and enough for limited irrigation use. The glaciated part of the "Big Flat" area at a depth of less than 50 feet is underlain by Flaxville gravel, which is a good aquifer. In some valleys Flaxville gravel is exposed, or the valleys are filled with gravelly alluvium. Fox Hills sandstone underlying the gravel is also considered a good ground water aquifer in this area.

Igneous bedrock in the Bearpaw Mountains is not generally a source of ground water. Wells, in valleys and basins, drilled through extrusive igneous rock into Judith River and Eagle Sandstone Formations produce enough water for domestic and livestock use. Numerous springs produce good water from bedrock in the valleys and on the sides of the mountains.

The main source of ground water in the Little Rocky Mountains is the gravel-filled alluvium in narrow valleys. Some springs occur on the sides of mountains.

Other sources of water include an artesian aquifer between Bean Creek and Snake Creek, but little information is available on this aquifer. Several wells about 3,000 feet deep to Madison limestone supply water to the Bowes oilfield, about 5 miles south of Chinook. Good water from shallow wells can be obtained locally from outwash deposits on the glaciated plains.

natural resources

In addition to the soil, other important natural resources within the survey area are petroleum, natural gas, lignite coal, bentonite clay, timber, and gravel. The full extent of these resources is not generally known, or the resources have not been developed.

The Bowes oilfield, about 5 miles south of Chinook, on part of the Bearpaw Arch which surrounds the Bearpaw Mountains, has been in production since 1950. It produces asphalt-base crude from an area of about 2 square miles. Another small oilfield, about 5 miles northeast of Chinook, has been in production since 1973. The petroleum is shipped out of the survey area for refining.

Natural gas was discovered in the Bearpaw Arch in 1926 during development of the Bowes oilfield. Low gas prices deterred development until 1966 when the Tiger Ridge gasfield began operations. A compressor station and a pipeline to transport most of the gas out of the area were completed in 1972. Natural gas from the Bowes field and some gas from the Tiger Ridge field is used locally.

Discontinuous lignite coalbeds occur in the shale strata that underlie most of the area. Some lignite coalbeds that are commercially suitable for stripmining occur in areas north and south of the Milk River Valley in the Western part of Blaine County. Some core drilling has been done to establish location, extent, and thickness of these coal seams.

Bentonite clay deposits, which outcrop along Thirty-Mile Coulee northwest of Harlem, have been explored, and mining claims have been filed on most of the exposed beds.

In some parts of the area, deposits of gravel and sand are extensive. These deposits generally are associated with glacial outwash and old terraces. Locally, they provide gravel and sand for road construction and for making concrete.

There are more than 80,000 acres of woodland where the canopy cover of trees is more than 15 percent, but only about 18,000 acres in the survey area are considered potentially suitable for commercial timber production. The potential areas are mostly on north and east slopes in the Little Rocky Mountains and on some north slopes in the west-central part of the Bearpaw Mountains. Noncommercial stands of ponderosa pine cover some of the shale and sandstone uplands in the southern part of the survey area. There are such stands also in the Bearpaw Mountains and in parts of the Little Rocky Mountains. Small areas adjacent to the Milk River and its principal tributaries have noncommercial stands of cottonwood trees.

Gold and silver have been mined in the survey area, but mining operations ceased in the late 1950's because the low volume of ore made mining in this area unprofitable.

physiography and drainage

The survey area varies widely in parent material and in landforms. Six major landforms make up most of the area. These are (1) the glaciated plains, (2) Bearpaw Mountains, (3) Milk River Valley, (4) shale and sandstone uplands, (5) a large glacial outwash plain in the northeastern part of the area known locally as the "Big Flat", and (6) the Little Rocky Mountains.

The glaciated plains make up the northern two-thirds of the survey area except for the "Big Flat" and the Milk River Valley. These plains formed during several periods of late Wisconsin glaciation. The landscape ranges from nearly level to gently rolling in some areas and from strongly rolling to steep in other areas. The glacial till ranges in thickness from a few feet to about 200 feet; it generally is underlain by loamy and clayey shale. Major drainage systems are deeply entrenched, and they drain into the Milk River. The elevation ranges from about 2,300 to 3,800 feet. The climate is semiarid continental; precipitation ranges from 10 to 17 inches annually.

The Bearpaw Mountains make up an area in the southwestern part of the survey area between the glaciated plains and the shale and sandstone uplands. Large dikes and sills radiate from the peaks and ridges, and extrusive igneous rock covers the slopes and basins that are generally underlain by sedimentary bedrock. Drainage systems are well established but generally are not deeply entrenched. The elevation ranges from about 3,300 to 6,000 feet. Precipitation ranges from 14 to 19 inches annually. The northwestern part receives the most moisture.

The Milk River Valley extends east-west through the north-central part of the survey area. On the average, it is about 4 miles wide, except for a small area on the western boundary of Blaine County where it is only about 1 mile wide. It is part of the preglacial channel of the Missouri River. The land is used mostly for irrigated crops. The elevation ranges from 2,300 to 2,500 feet. Precipitation ranges from 10 to 14 inches annually.

The shale and sandstone uplands make up a large area in the southwestern part of the survey area. These uplands extend north of the Missouri River to the Bearpaw Mountains and Little Rocky Mountains. The

landscape ranges from broad rolling ridges to steep or very steep broken areas. Residual bedrock is mainly clayey shale of the Bearpaw Formation overlying soft shale and sandstone of the Judith River and Claggett Formations. Extensive faulting occurred during the uplift of the mountains. Steep, severely eroded bluffs and drainageways border the Missouri River. The elevation ranges from about 2,300 to 4,000 feet. Precipitation ranges from 10 to 14 inches annually.

The "Big Flat" area is in the northeastern part of Blaine County. Although this area was glaciated, it differs from the normal glaciated plains in that it is on a low plateau that escaped severe glacial scouring. It formed mainly from water-sorted glacial till and has smoother relief than is typical of glaciated plains. Flaxville gravel underlies the "Big Flat" area at a depth of about 30 to 100 feet except in small valleys. The small valleys are either filled with loose gravel and sand or beds of Flaxville gravel. Drainage systems are weakly defined except for the deeply entrenched Woody Island Coulee and its tributaries. The elevation ranges from 3,000 to 3,400 feet. The climate is semiarid continental. Precipitation ranges from 10 to 14 inches annually.

The Little Rocky Mountains occupy a small area in the extreme southeastern part of the survey area. These mountains are mainly igneous uplift through beds of Madison limestone. The relief is mostly rugged, and the north- and east-facing slopes are generally forested. The elevation ranges from about 4,000 to 6,000 feet. Drainage systems are well established and are deeply entrenched in some areas of limestone bedrock. Precipitation ranges from 17 to 25 inches annually.

All of the survey area is drained by two major drainage systems, the Milk River and the Missouri River. The Milk River drains approximately the northern two-thirds of the area, although some of the tributaries flow into the river outside the area. The principal tributaries of the Milk River are Lodge, Battle, Thirty Mile, Woody Island, Wayne, and Savoy Creeks from the north and Clear, Bean, Snake, White Bear, and Peoples Creeks from the south. The principal tributaries of the Missouri River in the survey area are Black, Bullwhacker, and Cow Creeks. Most of the creeks south of the Milk River Valley have their headwaters in the Bearpaw Mountains and Little Rocky Mountains.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

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

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

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

soil descriptions

The soils in this survey area have been grouped into six general kinds of landscapes for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the paragraphs that follow. The terms for texture in the legend that follows the name of the map unit apply to the texture of the surface layer.

nearly level, deep, well drained to somewhat poorly drained soils on flood plains and stream terraces

The soils in this general group are on flood plains and stream terraces in valleys. The average annual precipitation ranges from 10 to 14 inches, and the frost-free season is 105 to 125 days. The soils are used mainly for irrigated crops. In some areas they are used for dryland crops and range. Areas of range have sparse to dense stands of brush and cottonwood trees. Irrigated crops are wheat, barley, alfalfa hay, sugar beets, and corn for silage. Dryland crops are mainly wheat and barley.

1. Harlem-Havre-Lardell

Nearly level, deep, well drained to somewhat poorly drained, nonsalt-affected to very strongly salt-affected, nonsodium-affected to very strongly sodium-affected silty clay loams and loams

The soils in this map unit are on the flood plains and stream terraces of the Milk River Valley and its major tributaries. Slopes are 0 to 2 percent.

This unit makes up about 5 percent of the survey area. It consists of about 30 percent Harlem soils, 30 percent Havre soils, 15 percent Lardell and similar soils, and 25 percent minor soils, including Bowdoin, Glendive, Hanley, Harlem Variant, Havre Variant, and Nobe soils.

The Harlem soils have a surface layer of silty clay loam. The underlying material is silty clay loam stratified with thin lenses of clay loam, silty clay, and other material. These soils range from nonsalt-affected to moderately salt-affected and from nonsodium-affected to moderately sodium-affected.

The Havre soils have a loam surface layer. The underlying material is loam stratified with thin lenses of fine sandy loam to clay loam. Havre soils range from nonsalt-affected to moderately salt-affected and from nonsodium-affected to moderately sodium-affected.

The Lardell soils have a surface layer of silty clay loam. The underlying material is silty clay loam and loam stratified with thin lenses of fine sandy loam to silty clay loam. Lardell soils are very strongly salt-affected and very strongly sodium-affected.

The soils that are nonaffected to moderately affected by salt and sodium are used mainly for irrigated crops and for range. The crops are alfalfa hay, corn for silage, wheat, and barley. The soils that are strongly or very strongly salt-affected and sodium-affected are used mainly for range.

The soils in this unit have good potential for the development of habitat for wildlife, including white-tailed deer and other mammals and pheasants, ducks, and nongame birds. The streams have good potential for catfish, bass, trout, and pike.

nearly level to steep, deep and shallow, well drained soils on northern glaciated plains

The soils of the northern glaciated plains formed in glacial till. The average annual precipitation ranges from 10 to 14 inches, and the frost-free season is 100 to 125 days. The soils are used mainly for dry-farmed crops and range. In a few small areas they are used for irrigated crops. The native vegetation is mainly mid and short grasses.

There are four map units in this group.

2. Kevin-Scobey-Hillon

Nearly level to steep, deep, well drained clay loams

This map unit is on the glaciated plains in the northeastern part of the survey area. Slopes range from 0 to 45 percent.

This unit makes up about 9 percent of the survey area. It consists of about 30 percent Kevin soils, 20 percent Scobey soils, 20 percent Hillon soils, and 30 percent minor soils, including Assinniboine, Chinook, Dimmick, Elloam, Joplin, Nishon, Phillips, and Telstad soils.

Kevin soils are nearly level to hilly. They are clay loam throughout.

Scobey soils are nearly level to gently rolling. They are clay loam throughout.

Hillon soils are strongly rolling to steep. They are clay loam throughout.

The soils in this unit are used mainly for dryland crops and for range. Wheat and barley are the principal crops. The native vegetation is mainly mid and short grasses.

The soils in this unit have good potential for habitat for wildlife, including pronghorn antelope, mule deer, and other mammals, pheasants, sharp-tailed grouse, gray (or Hungarian) partridge, and nongame birds.

3. Telstad-Joplin

Nearly level to gently rolling, deep, well drained loams

The soils in this map unit are on the glaciated plains in the northeastern and the central parts of the survey area. Slopes range from 0 to 8 percent.

This unit makes up about 9 percent of the survey area. It consists of about 70 percent Telstad soils, 10 percent Joplin soils, and about 20 percent minor soils, including Assinniboine, Attewan, Beaverell, Chinook, Hillon, Nishon, and Wabek soils.

The Telstad soils are nearly level to gently rolling. They have a loam surface layer, a clay loam subsoil, and a clay loam substratum.

The Joplin soils are nearly level to gently rolling. They have a loam surface layer, a clay loam and loam subsoil, and a loam substratum.

The soils in this unit are used mainly for dryland crops, but in some areas they are used for range. The native vegetation is mainly short and mid grasses.

These soils have good potential for habitat for pronghorn antelope and other mammals and nongame birds.

4. Phillips-Elloam-Thoeny

Nearly level to gently rolling, deep, well drained, nonsodium-affected and slightly sodium-affected loams and moderately sodium-affected clay loams

This map unit is on the glaciated plains in the northern and the east-central parts of the survey area. Slopes range from 0 to 8 percent.

This unit makes up about 24 percent of the survey area. It consists of about 35 percent Phillips soils, 20 percent Elloam soils, 10 percent Thoeny soils, and 35 percent minor soils, including Assinniboine, Chinook, Kevin, Nobe, Scobey, and Telstad soils.

Phillips soils are nearly level to gently rolling. They have a loam surface layer, a clay and clay loam subsoil, and a clay loam substratum.

Elloam soils are nearly level to gently rolling. They have a clay loam surface layer, a clay loam subsoil, and a clay loam substratum. They are moderately sodium-affected.

Thoeny soils are nearly level to gently rolling. They have a loam surface layer, a clay and clay loam subsoil, and a clay loam substratum. They are slightly sodium-affected.

The soils in this unit are used for range and for dryland crops. Wheat, barley, and oats are the main dryland crops. The native vegetation is short and mid grasses.

The soils have good potential for the development of habitat for pronghorn antelope, mule deer, and other mammals and sage grouse, sharp-tailed grouse, and nongame birds.

5. Hillon-Lisam-Cabbart

Moderately steep and steep, deep and shallow, well drained loams, clay loams, and clays

The soils in this map unit are in the northern half of the survey area, mainly along the Milk River Valley. They are in areas where the glacial till has been partly or entirely eroded away and soft shale has been exposed. Slopes range from 15 to 45 percent.

This unit makes up about 4 percent of the survey area. It consists of about 45 percent Hillon soils, 20 percent Lisam soils, 15 percent Cabbart soils, and 20 percent minor soils, including Bascovy, Dilts, Kevin, Marvan, Vanda, and Yamac soils. Areas of shale outcrop are included.

Hillon soils are hilly and steep. They formed in glacial till. They are clay loam throughout.

Lisam soils are steep. They formed in thin bedded shale. They have a clay surface layer, clay underlying material, and shale bedrock below a depth of 17 inches.

Cabbart soils are steep. They formed in siltstone. They have a loam surface layer, loam underlying material, and soft siltstone bedrock below a depth of 12 inches.

The soils in this map unit are used mainly for range. The native vegetation is mainly short and mid grasses.

The soils have good potential for use as habitat for wildlife, including pronghorn antelope, mule deer, and other mammals and sage grouse, sharp-tailed grouse, and nongame birds.

nearly level to steep, deep, well drained soils on southern glaciated plains

The soils of the southern glaciated plains formed in glacial till. This is the southernmost extent of the glaciation in the survey area. The average annual

precipitation ranges from 13 to 17 inches, and the frost-free season is 100 to 125 days. The soils are used mainly for dry-farmed crops and range. In some areas they are used for irrigated crops. The native vegetation is mainly mid grasses.

There are two map units in this group.

6. Vida-Bearpaw-Zahill

Nearly level to steep, deep, well drained clay loams

This map unit is on the rolling glaciated plains in a wide band that extends from the west-central part to the southeastern part of the survey area. All of this unit is south of the Milk River. Slopes range from 0 to 45 percent.

This unit makes up about 16 percent of the survey area. It consists of about 25 percent Vida soils, 20 percent Bearpaw soils, 15 percent Zahill soils, and 40 percent minor soils, including Cabba, Dimmick, Elloam, Nishon, and Williams soils.

Vida soils are undulating to hilly and are clay loam throughout.

Bearpaw soils are nearly level to gently rolling and are clay loam throughout.

Zahill soils are strongly rolling to steep and are clay loam throughout.

The soils in this map unit are used for dryland and irrigated crops and for range. Wheat and barley are the main dryland crops. Wheat, barley, and alfalfa hay are the main irrigated crops. Large areas of these soils are used for range. The native vegetation is mainly wild grasses.

The soils have good potential for habitat for wildlife, including pronghorn antelope, mule deer, and other mammals and pheasants, sharp-tailed grouse, gray (Hungarian) partridge, and nongame birds.

7. Bearpaw-Vida-Elloam

Nearly level to gently rolling, deep, well drained clay loams; moderately sodium-affected in some areas

This map unit is on the glaciated plains in the central part of the survey area. Slopes range from 0 to 8 percent.

This unit makes up about 1 percent of the survey area. It consists of about 40 percent Bearpaw soils, 25 percent Vida soils, 15 percent Elloam soils, and 20 percent minor soils, including Creed, Korent, Savage, and Straw soils.

Bearpaw soils are nearly level to gently rolling and clay loam throughout.

Vida soils are undulating and gently rolling and clay loam throughout.

Elloam soils are nearly level and gently sloping. They are clay loam throughout and are moderately sodium-affected.

The soils in this unit are used for dryland and irrigated crops and for range. Wheat and barley are the main dryland crops. Wheat, barley, and alfalfa hay are the main irrigated crops. Large areas are used for range. The native vegetation is mainly mid grasses.

The soils have good potential for the development of habitat for wildlife, including pronghorn antelope, mule deer, and other mammals and pheasants, sharp-tailed grouse, gray (Hungarian) partridge, and nongame birds.

nearly level to steep, deep, well drained and excessively drained soils on terraces and fans

The soils in this group are on terraces and fans on uplands. They formed in alluvium. The average annual precipitation ranges from 10 to 19 inches, and the frost-free period is 100 to 125 days. These soils are used mainly for range and for dryland crops. The native vegetation is mainly mid and short grasses.

There are three map units in this group.

8. Attewan-Wabek-Beaverell

Nearly level to steep, deep, well drained and excessively drained loams and gravelly loams

This map unit is on terraces and fans in the northeastern part of the survey area. Slopes range from 0 to 35 percent.

This unit makes up about 2 percent of the survey area. It consists of about 45 percent Attewan soils, 20 percent Wabek soils, 10 percent Beaverell soils, and 25 percent minor soils, including Assinniboine, Chinook, and Joplin soils.

The Attewan soils are nearly level and gently sloping. They have a loam surface layer, a clay loam subsoil, and a clay loam substratum over gravelly loamy sand at a depth of 25 inches.

The Wabek soils are undulating to steep. The surface layer is gravelly loam, and the underlying material is very gravelly coarse sand.

The Beaverell soils are nearly level and gently sloping. The surface layer is gravelly loam. The subsoil is very gravelly clay loam and sandy clay loam. The substratum is very gravelly loamy sand and sand.

The soils in this map unit are used mainly for range and for dryland crops. A small acreage is used for irrigated wheat, barley, oats, and alfalfa hay. The main dry-farmed crops are wheat and barley. The native vegetation is mainly short and mid grasses.

The soils have good potential for habitat for pronghorn antelope and other mammals and nongame birds.

9. Martinsdale-Shawmut-Turner

Nearly level to gently rolling, deep, well drained clay loams, gravelly loams, and loams

This map unit is on terraces and fans in the south-central part of the survey area. Slopes range from 0 to 8 percent.

This unit makes up about 2 percent of the survey area. It consists of about 30 percent Martinsdale soils, 15

percent Shawmut soils, 15 percent Turner soils, and 40 percent minor soils, including Beaverton, Farnuf, Judith, Shaak, Windham, and Work soils.

Martinsdale soils are nearly level to gently rolling. They have a clay loam surface layer and a clay loam subsoil. The substratum is clay loam and gravelly clay loam.

Shawmut soils are nearly level to moderately sloping. They have a gravelly loam surface layer. The upper part of the subsoil is gravelly clay loam, and the lower part is very gravelly clay loam. The upper part of the substratum is very gravelly loam, and the lower part is extremely gravelly loam.

Turner soils are nearly level to gently rolling. The surface layer is loam, and the subsoil is clay loam and sandy clay loam. The substratum is clay loam and gravelly loam to a depth of 26 inches and, below that, very gravelly loamy sand to a depth of 60 inches.

The soils in this map unit are used for range and for dryland crops. A small acreage is used for irrigated alfalfa hay. The dryland crops are wheat, barley, and oats. The native vegetation is mainly mid and short grasses.

The soils have potential for the development of habitat for pronghorn antelope and other mammals and nongame birds.

10. Shaak-Attewan-Work

Nearly level to moderately sloping, deep, well drained loams and clay loams

This map unit is on terraces and fans in the southwestern part of the survey area. Slopes range from 0 to 8 percent.

This unit makes up about 1 percent of the survey area. It consists of about 30 percent Shaak soils, 25 percent Attewan soils, 25 percent Work soils, and 20 percent minor soils, including Beaverell, Gerdrum, Martinsdale, and Turner soils.

Shaak soils are nearly level and gently sloping. The surface layer is loam, and the subsoil is clay and clay loam. The substratum is gravelly sandy clay loam and very gravelly sandy loam.

Attewan soils are nearly level and gently sloping. The surface layer is loam, and the subsoil is clay loam. The substratum is clay loam to a depth of 25 inches. Below that, to a depth of 60 inches, it is very gravelly loamy sand.

Work soils are nearly level to moderately sloping. The surface layer is clay loam. The subsoil is clay in the upper part and clay loam in the lower part. The substratum is gravelly clay loam.

The soils in this map unit are used for range and for dryland and irrigated crops. The main dryland crops are wheat and barley. The main irrigated crops are wheat, barley, and alfalfa hay. The native vegetation is mainly mid and short grasses.

The soils have good potential for habitat for pronghorn antelope and other mammals and nongame birds.

gently sloping to very steep, shallow to deep, well drained soils on shale and sandstone uplands

These are soils of the uplands. They formed in material that weathered from shale and sandstone. The average annual precipitation ranges from 10 to 18 inches, and the frost-free period is 100 to 125 days. The soils are used mainly for range. In some areas they are used for dryland crops. The native vegetation is mainly mid and short grasses.

There are five map units in this group.

11. Cabbart-Delpoint

Undulating to steep, shallow to moderately deep, well drained loams

This map unit is on uplands in the southwestern part of the survey area. Slopes range from 2 to 35 percent.

This unit makes up about 2 percent of the survey area. It consists of about 35 percent Cabbart soils, 25 percent Delpoint soils, and 40 percent minor soils, including Dilts, Lisam, Marmarth, Riedel, Twilight, and Yamac soils. Small areas of shale outcrop and sandstone outcrop are also included.

Cabbart soils are undulating to steep. The surface layer is loam, and the underlying material is loam. Soft siltstone bedrock is at a depth of 12 inches.

Delpoint soils are undulating to strongly rolling. The surface layer and subsoil are loam. The substratum is clay loam. Soft siltstone bedrock is at a depth of 32 inches.

The soils in this map unit are used mainly for range. A small acreage is used for dryland crops. The main dryland crops are wheat and barley. The native vegetation is mainly mid and short grasses.

The soils have good potential for use as habitat for pronghorn antelope, mule deer, and other mammals and sage grouse, sharp-tailed grouse, and nongame birds.

12. Barkof-Cabba-Windham

Undulating to steep, shallow to deep, well drained clay loams and gravelly loams

This map unit is on uplands in the southeastern part of the survey area. Slopes range from 2 to 45 percent.

This unit makes up about 2 percent of the survey area. It consists of about 40 percent Barkof soils, 25 percent Cabba soils, 20 percent Windham soils, and 15 percent minor soils, including Castner, Farnuf, Marvan, Norbert, Perma, and Vanda soils. Small areas of shale outcrop and sandstone outcrop are included.

Barkof soils are undulating to steep. The surface layer and subsoil are clay. Shale bedrock is at a depth of 28 inches.

Cabba soils are strongly rolling to steep. The surface layer and underlying material are loam. Soft siltstone bedrock is at a depth of 12 inches.

Windham soils are gently rolling to steep. The surface layer is gravelly loam. The subsoil and substratum are very gravelly loam.

The soils in this map unit are used mainly for range. A small acreage is used for dryland crops of wheat and barley and irrigated crops of alfalfa hay. The native vegetation is mainly mid and short grasses and shrubs. Ponderosa pine grows in some areas.

The soils have good potential for use as habitat for pronghorn antelope, mule deer, and other mammals and sage grouse, sharp-tailed grouse, and nongame birds.

13. Lisam-Dilts-Bascovy

Gently sloping to steep, shallow to moderately deep, well drained clays

This map unit is on uplands in the southern part of the survey area. Slopes range from 2 to 35 percent.

This unit makes up about 4 percent of the survey area. It consists of about 30 percent Lisam soils, 25 percent Dilts soils, 15 percent Bascovy soils, and 30 percent minor soils, including Marvan, Nobe, and Vanda soils. Small areas of shale outcrop are included.

Lisam soils are gently rolling to steep. The surface layer and the underlying material are clay. Shale bedrock is below a depth of 17 inches.

Dilts soils are gently rolling to steep. The surface layer and the underlying material are clay. Shale bedrock is below a depth of 16 inches.

Bascovy soils are gently sloping and moderately sloping. The surface layer, subsoil, and substratum are clay. Shale bedrock is at a depth of 23 inches.

The soils in this unit are used mainly for range. The native vegetation is mainly mid and short grasses and shrubs.

The soils have good potential for use as habitat for pronghorn antelope, mule deer, and other mammals and for sage grouse, sharp-tailed grouse, and nongame birds.

14. Lisam-Dilts-Rock outcrop, shale

Steep, shallow, well drained clays and steep and very steep shale outcrops

This map unit is on uplands mainly in the southwestern part of the survey area. Slopes range from 25 to 60 percent.

This unit makes up about 5 percent of the survey area. It consists of about 30 percent Lisam soils, 25 percent Dilts soils, 25 percent Rock outcrop, shale and 20 percent minor soils, including Bascovy, Marvan, Nobe, and Vanda soils.

Lisam soils are steep and are mainly on hills and ridges. The surface layer and underlying material are clay. Shale bedrock is below a depth of 17 inches.

Dilts soils are steep and are on hills and ridges. The surface layer and underlying material are clay. Shale bedrock is below a depth of 16 inches.

The areas of shale outcrops are steep and very steep. They are on the sides of hills and ridges and along deeply eroded drainageways.

The soils in this map unit are used for range. The native vegetation is mainly short and mid grasses and shrubs. Ponderosa pine and juniper grow in some areas.

The soils have good potential for habitat for wildlife, including pronghorn antelope, mule deer, and other mammals and sage grouse, sharp-tailed grouse, and nongame birds.

15. Badland-Cabbart

Steep and very steep badlands and moderately steep to very steep, shallow, well drained loams

This map unit is in the southwestern part of the survey area. Slopes range from 15 to 70 percent.

This unit makes up about 4 percent of the survey area. It consists of about 40 percent Badland, 20 percent Cabbart soils, and 40 percent minor soils, including Delpoint, Lisam, Riedel, and Twilight soils. Areas of Rock outcrop, shale, are included.

Badland is on steep and very steep canyon walls, eroded areas along drainageways and ridges, and bluffs along the Missouri River.

Cabbart soils are moderately steep to very steep. The surface layer and the underlying material are loam. Soft siltstone bedrock is at a depth below 12 inches.

The soils in this map unit are used for range. The native vegetation of short and mid grasses, shrubs, ponderosa pine, and juniper is mainly on the Cabbart soils and the minor soils.

The soils have good potential for habitat for wildlife, including mule deer, white-tailed deer, elk, and other mammals and sharp-tailed grouse and nongame birds.

gently sloping to very steep, shallow to deep, well drained soils on mountains

These are soils of the mountains. They formed in material that weathered from igneous limestone, sandstone, and other metamorphic rock. The average annual precipitation ranges from 14 to 25 inches, and the frost-free period is 80 to 110 days. The soils are used mainly for range and woodland. In some areas they are used for dry-farmed and irrigated crops. A small amount of timber is produced on some of these soils.

There are two map units in this group.

16. Hedoes-Belain-Castner

Gently sloping to very steep, shallow to deep, well drained loams and gravelly loams

This map unit is mainly in the Bearpaw Mountains in the southwestern part of the survey area. Slopes range from 2 to 60 percent.

This unit makes up about 9 percent of the survey area. It consists of about 25 percent Hedoes soils, 20 percent Belain soils, 20 percent Castner soils, and 35 percent minor soils, including Benz, Farnuf, and Perma soils. Areas of Rock outcrop, shale, are included.

Hedoes soils are gently sloping to steep. The surface layer and subsoil are loam. The substratum is coarse

sandy loam in the upper part and very gravelly coarse sandy loam in the lower part.

Belain soils are gently sloping to steep. The surface layer is loam, and the subsoil is loam and gravelly loam. The substratum is gravelly and very gravelly loam. It is underlain by igneous bedrock at a depth of 28 inches.

The Castner soils are strongly sloping to very steep. The surface layer is gravelly loam. The underlying material is very channery loam. Hard sandstone bedrock is at a depth below 13 inches.

The soils in this map unit are used mainly for range. In some small areas they are used for dryland and irrigated crops. The main dryland crops are wheat and barley. The main irrigated crops are wheat, barley, and alfalfa hay. The native vegetation is mid and short grasses. Ponderosa pine is growing on some of the soils.

The soils in this unit have good potential for use as habitat for wildlife, including elk, mule deer, white-tailed deer, and other mammals and Merriam's turkey, blue grouse, and nongame birds.

17. Whitecow-Macmeal-Warneke

Steep and very steep, shallow and deep, well drained gravelly loams

This map unit is mainly in the Little Rocky Mountains in the southeastern part of the survey area. Slopes range from 25 to 70 percent.

This unit makes up about 1 percent of the survey area. It is about 45 percent Whitecow soils, 20 percent Macmeal soils, 10 percent Warneke soils, and 25 percent minor soils, including Castner, Lolo, and Silverchief soils. Small areas of rock outcrop are included.

Whitecow soils are steep and very steep. The surface layer is gravelly loam, the subsoil is very gravelly loam, and the substratum is extremely gravelly loam.

Macmeal soils are steep and very steep. The surface layer is gravelly loam. The subsoil is very gravelly clay loam and extremely channery loam to a depth of 60 inches.

Warneke soils are steep and very steep. The surface layer is gravelly loam, and the subsoil is very channery loam. Limestone bedrock is at a depth of 15 inches.

The soils in this map unit are used mainly as rangeland. They have limited use for timber production.

These soils have good potential for use as habitat for wildlife, including elk, mule deer, white-tailed deer, and other mammals and Merriam's turkey, blue grouse, and nongame birds.

detailed soil map units

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

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

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

For this survey, soils were mapped at two levels of detail. The soils mapped in greater detail are called narrowly defined map units. Those mapped in lesser detail are called broadly defined map units. The boundaries of the narrowly defined map units were plotted and verified at closely spaced intervals. The boundaries of the broadly defined map units were plotted and verified at greater intervals. The intensity of mapping for a given soil was based on the anticipated long-term use of the soil. The broadly defined map units are identified by an asterisk in the soil legend.

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, 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, Hedoes loam, 2 to 4 percent slopes, is one of several phases in the Hedoes series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Chinook-Phillips complex, 2 to 6 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Cabba-Zahill association, steep, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Havre, Hanly and Glendive soils, channeled, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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.

soil descriptions

1—Absher-Nobe complex, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping soils on fans and terraces on uplands throughout the survey area. These soils are at an elevation of 2,300 to 3,600 feet. The average annual precipitation is 12

inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Absher soil makes up about 60 percent of this map unit, and the Nobe soil makes up about 30 percent. Included with these soils in mapping are small areas of Benz, Creed, and Vanda soils. These soils make up about 10 percent of this unit.

The Absher soil is deep and moderately well drained. It formed in alluvium, and it is in smooth areas. Typically, the surface layer, where mixed, is light brownish gray clay loam to a depth of 7 inches. The subsoil is grayish brown clay 13 inches thick. The substratum is grayish brown clay loam to a depth of 40 inches; below that, it is clay loam stratified with lenses of loam and silty clay loam to a depth of 60 inches.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in those areas that are in native vegetation is 29 inches. Runoff is slow. Wind erosion is a moderate hazard and water erosion a slight hazard. The subsoil, in the lower 11 inches, is strongly affected by sodium. When dry, it is very hard, and it hinders the penetration of roots and moisture.

The Nobe soil is deep and moderately well drained. It formed in alluvium in depressions on fans and terraces. Typically, the surface layer, where mixed, is grayish brown clay to a depth of 7 inches. The substratum is grayish brown clay to a depth of 30 inches; below that, it is olive silty clay to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 60 inches, but the subsoil, which is strongly affected by sodium, is very hard when dry and thus hinders root penetration. The average annual wetting depth of the soil in those areas that are in native vegetation is 20 inches. Runoff is slow. The wind erosion is a moderate hazard, and water erosion is a slight hazard.

Because the soils in this complex are strongly affected by sodium, they are poorly suited to cultivated crops.

These soils are suited to use as rangeland, and they are used as rangeland. Most of the forage is produced on the Absher soil.

The potential plant community on the Absher soil consists mainly of western wheatgrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. On the Nobe soil it is western wheatgrass, prairie junegrass, inland saltgrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants, such as western wheatgrass, Nuttall alkaligrass, and Nuttall saltbush, and an increase of plants such as inland saltgrass, shrubby cinquefoil, foxtail barley, broom snakeweed, plains pricklypear, and curlycup gumweed.

On the Absher soil, the potential plant community produces 400 pounds of forage per acre in favorable years and 100 pounds per acre in unfavorable years. On the Nobe soil, forage production is 200 pounds per acre in favorable years and 75 pounds per acre in unfavorable years.

The Absher and Nobe soils are not suitable for windbreaks because they are strongly affected by sodium.

The very slow permeability, low soil strength, and high shrink-swell potential limit these soils for most urban uses. Septic tank absorption fields require special design because of the very slow permeability. Foundations and basements for houses require special design because of the shrink-swell potential and low soil strength.

Capability subclass VIs, dryland. Absher soil: Dense Clay range site, 10- to 14-inch precipitation zone; Nobe soil: Saline Upland range site, 10- to 14-inch precipitation zone.

2—Assinniboine fine sandy loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil that formed in alluvium or eolian materials on glaciated uplands. It is at an elevation of 2,500 to 3,500 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown fine sandy loam 5 inches thick. The upper part of the subsoil is brown fine sandy loam about 4 inches thick. The lower part is brown sandy clay loam 12 inches thick. The substratum is grayish brown fine sandy loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil where it is under native vegetation is 36 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard.

Small areas of Cozberg and Chinook soils are included with this soil in mapping.

The Assinniboine soil is used mainly as rangeland. In some areas it is used for dryland crops, mainly wheat, barley, and oats.

Wind erosion is the main limitation to use of this soil for cultivated crops. Effective methods for controlling wind erosion include stripcropping, tall grass barriers, minimum tillage, and stubble mulch tillage. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, needleandthread, western wheatgrass, and forbs. If the rangeland is overgrazed, Indian ricegrass and prairie sandreed decrease and prairie junegrass, needleandthread, blue grama, and fringed sagewort increase. Annual grasses and clubmoss are likely to invade. The potential heavy infestation by clubmoss is a very serious problem.

The potential plant community produces 1,600 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses. Underground water supplies can be polluted by liquid and solid waste disposal systems because of the moderately rapid permeability of the underlying material.

Capability subclass IIIe, dryland; Sandy range site, 10- to 14-inch precipitation zone.

3—Attewan loam, 0 to 4 percent slopes. This soil is deep and well drained. It formed in alluvium on outwash terraces in the uplands at an elevation of 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 14 inches thick. The upper part of the substratum is light brownish gray loam 5 inches thick, and the lower part, to a depth of 60 inches or more, is grayish brown, very gravelly loamy sand. A layer of sand and gravel is at a depth of 20 to 40 inches.

Permeability is moderate above the layer of sand and gravel and rapid or very rapid in that layer. The available water capacity is moderate or low. The root zone extends to a depth of about 30 inches. The average annual wetting depth of the soil in areas that are in native vegetation is about 30 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is droughty.

Small areas of Beaverell and Wabek soils are included in mapping. The Beaverell soil is nearly level and gently sloping. The Wabek soil is gently sloping, and it is on mounds or low knolls.

This soil is used mainly for range and for dryland crops, mainly wheat, barley, and oats. In some small areas it is used for irrigated crops, mainly wheat, barley, oats, and alfalfa.

Wind erosion and droughtiness are the main limitations to the use of this soil for cultivated crops. Stripcropping, tall grass barriers, minimum tillage, and mulch tillage help control wind erosion. Crop residue left on the surface, minimum tillage, and tall grass barriers for trapping windblown snow help to conserve moisture.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease; needleandthread, blue grama, and fringed sagewort increase; and annual grasses, broom snakeweed, and clubmoss invade.

The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil is suited to windbreaks. The moderate or low available water capacity restricts the choice of trees and shrubs to those that are drought-resistant. Russian-olive, Siberian elm, Siberian crabapple, green ash, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper are suitable trees. Siberian peashrub, common chokecherry, American plum, and silver buffaloberry are suitable shrubs.

This soil is suited to most urban uses. Because of the rapid or very rapid permeability of the substratum, waste disposal systems can pollute underground water supplies.

Capability subclass is IIIs, dryland, and IIs, irrigated; Silty range site, 10- to 14-inch precipitation zone.

4—Attewan-Beaverell complex, 0 to 4 percent slopes. This complex consists of Attewan and Beaverell soils on outwash terraces in the uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Attewan soil makes up about 55 percent of this map unit, and the Beaverell soil makes up about 30 percent. Included in mapping are small areas of Chinook and Wabek soils, which together make up about 15 percent of the map unit.

The Attewan soil is deep and well drained. It formed in alluvium on the smooth parts of terraces. Typically, the surface layer is brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 14 inches thick. The substratum in the upper 5 inches, is light brownish gray clay loam. Below that, to a depth of 60 inches or more, it is grayish brown, very gravelly loamy sand. A layer of sand and gravel is at a depth of 20 to 40 inches.

Permeability is moderate above the layer of sand and gravel and rapid or very rapid in that layer. The available water capacity is moderate. The root zone extends to a

depth of about 30 inches. The average annual wetting depth of the soil where it is under native vegetation is 30 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is droughty.

The Beaverell soil is deep and well drained. It formed in alluvium on low knolls and ridges. Typically, the surface layer is brown gravelly loam 3 inches thick. The subsoil is brown gravelly clay loam and very gravelly sandy clay loam 8 inches thick. The upper part of the substratum is brown very gravelly sandy loam 6 inches thick; the lower part is brown gravelly sand to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and rapid or very rapid below that depth. The available water capacity is very low. The root zone extends to a depth of about 20 inches. The average annual wetting depth of the soil where it is under native vegetation is 20 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. Very gravelly sand is at a depth of 10 to 20 inches.

The soils in this complex are used mainly for range and for dryland crops, mainly wheat, barley, and oats. In some small areas they are used for irrigated crops, mainly wheat, barley, oats, and alfalfa.

Wind erosion and droughtiness are the main limitations to the use of these soils for cultivated crops. Stripcropping, tall grass barriers, minimum tillage, and mulch tillage help control wind erosion. Crop residue left on the surface, minimum tillage, and tall grass barriers for trapping windblown snow help to conserve moisture. The Beaverell soil especially is poorly suited to cultivated crops because it is very droughty. Yields are very low if the soil is cropped.

These soils are suited to use as rangeland. The potential plant community on the Attewan soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. The potential plant community on the Beaverell soil consists mainly of needleandthread, western wheatgrass, and prairie sandreed. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, needleandthread, prairie sandreed, and green needlegrass decrease; blue grama, fringed sagewort, and prairie junegrass increase; and annual grasses, red threeawn, broom snakeweed, and clubmoss invade.

On the Attewan soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Beaverell soil, forage production is 900 pounds per acre in favorable years and 500 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting. The expected yield of forage is good for the Attewan soil and fair or poor for the very droughty Beaverell soil.

These soils are suited to windbreaks. Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper are suitable trees on the Attewan soil. Siberian peashrub, common chokecherry, American plum, and silver buffaloberry are suitable shrubs. Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper are suitable trees on the Beaverell soil. Siberian peashrub, silver buffaloberry, and sandcherry are suitable shrubs. The Beaverell soil has a very low available water capacity, which restricts the choice of shrubs and trees to those that are drought resistant.

The soils in this complex are suited to most urban uses. Because of the rapid or very rapid permeability of the substratum, waste disposal systems can pollute underground water supplies.

Capability subclass IVs, dryland, and IIIs, irrigated. The Attewan soil is in Silty range site, 10- to 14-inch precipitation zone; the Beaverell soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone.

5—Attewan-Wabek complex, 0 to 4 percent slopes. This complex consists of Attewan and Wabek soils on outwash terraces in the uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Attewan soil makes up about 55 percent of the map unit, and the Wabek soil makes up 30 percent. Included in mapping are small areas of Beaverell and Chinook soils. These soils make up about 15 percent of this map unit.

The Attewan soil is deep and well drained. It formed in alluvium on the smooth parts of terraces. Typically, the surface layer is brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 14 inches thick. The substratum, in the upper 5 inches, is light brownish gray clay loam. Below that, to a depth of 60 inches or more, it is grayish brown, very gravelly loamy sand. A layer of sand and gravel is at a depth of 20 to 40 inches.

Permeability is moderate to a depth of about 25 inches and rapid or very rapid below that. The available water capacity is moderate. The root zone extends to a depth of about 30 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Surface runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. Very gravelly loamy sand is at a depth of 20 to 40 inches. This soil is droughty.

The Wabek soil is deep and excessively drained. It formed in alluvium on low knolls and ridges. Typically,

the surface layer is dark grayish brown and dark brown gravelly loam 8 inches thick. The upper part of the substratum is light brownish gray, very gravelly loamy coarse sand 7 inches thick. The lower part, to a depth of 60 inches or more, is grayish brown, very gravelly coarse sand.

Permeability is very rapid. The available water capacity is very low. The root zone extends to a depth of about 20 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Surface runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. Very gravelly coarse sand is at a depth of 6 to 14 inches. This soil is very droughty.

The soils in this complex are used mainly as rangeland. The potential plant community on the Attewan soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. The potential plant community on the Wabek soil consists mainly of needleandthread, western wheatgrass, and prairie sandreed. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, needleandthread, prairie sandreed, and green needlegrass decrease; blue grama, fringed sagewort, and prairie junegrass increase; and annual grasses, red threeawn, clubmoss, and broom snakeweed invade.

On the Attewan soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Wabek soil, forage production is 800 pounds per acre in favorable years and 400 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting. The expected yield of forage is good for the Attewan soil and fair or poor for the very droughty Wabek soil.

The Attewan soil is suited to windbreaks. The Wabek soil is not suited to windbreaks because it is very droughty. Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper are suitable trees on the Attewan soil. Siberian peashrub, common chokecherry, American plum, and silver buffaloberry are suitable shrubs.

The soils in this complex are suited to most urban uses. Because of the rapid or very rapid permeability of the substratum of the Attewan soil and the very rapid permeability of the substratum of the Wabek soil, waste disposal systems can pollute underground water supplies.

Capability subclass IVs, dryland. The Attewan soil is in Silty range site, 10- to 14-inch precipitation zone; the Wabek soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone.

6—Badland. This is a miscellaneous area consisting of barren land that is characterized by escarpments, narrow ridges, buttes, and deeply entrenched coulees. The elevation is 2,300 to 3,800 feet. Slopes range from 35 to 70 percent. This landscape was formed by the geologic erosion of soft, sedimentary bedrock.

Included in mapping are small areas of Cabbart and Lisam soils. These soils make up about 25 percent of this map unit.

Surface runoff is very rapid, and the hazard of erosion by wind and water is very severe.

Badland is used mainly as wildlife habitat and watershed and for recreation. The included soils support grasses, forbs, and shrubs and, in accessible areas, have limited use as rangeland. Grazing is difficult to manage. Extreme care must be used to prevent overgrazing and erosion.

7—Barkof clay, 4 to 8 percent slopes. This is a moderately deep, well drained soil on uplands. It formed in material that weathered from soft clayey shale. The elevation is 2,500 to 4,400 feet. Slopes are mainly short. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark grayish brown clay 7 inches thick. The subsoil is mostly grayish brown clay 21 inches thick. Below that, to a depth of 60 inches, there is platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 28 inches. Surface runoff is medium, and erosion by wind and water is a moderate hazard. Platy shale is at a depth of 20 to 40 inches.

Small areas of Norbert, Marvan, and Vanda soils are included in mapping. The Norbert soil is shallow and moderately and strongly sloping; it is on low knolls and ridges. The Vanda soil is gently and moderately sloping and strongly affected by sodium. It is on foot slopes and fans.

The Barkof soil is used mainly as rangeland. In some areas it is used for dryland crops, mainly wheat, barley, and oats.

Droughtiness and erosion by wind and water are the main limitations to the use of this soil for cultivated crops. Because of droughtiness, successful crop production is dependent on a suitable distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall-grass barriers for trapping windblown snow help to conserve moisture. Stripcropping, tall-grass barriers, minimum tillage, and stubble mulch tillage help control erosion by wind and water.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass. Some sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease; western wheatgrass, Idaho fescue, plains muhly, fringed sagewort, common snowberry, Woods rose, and big sagebrush increase; and Kentucky bluegrass, timothy, annual grasses, curlycup gumweed, and Hood phlox invade.

The potential plant community produces 2,400 pounds per acre of forage in favorable years and 1,300 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil is suited to windbreaks. The low available water capacity restricts the choice of shrubs and trees to those that are drought resistant. Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper are suitable trees. Siberian peashrub, silver buffaloberry, and sandcherry are suitable shrubs.

This soil is limited for most urban uses. Septic tank absorption fields require special design to overcome the limitations imposed by the slow permeability and the platy shale. Foundations and basements for houses require special design to overcome the limitations imposed by the shrinking and swelling of the soil and the low strength of the soil.

Capability subclass IIIe, dryland; Clayey range site, 15- to 19-inch precipitation zone.

8—Barkof-Norbert clays, 2 to 8 percent slopes. This complex consists of Barkof and Norbert soils on uplands. The elevation is 2,500 to 4,400 feet. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Barkof soil makes up about 50 percent of the map unit, and the Norbert soil makes up 35 percent. Included in mapping are small areas of Vanda and Marvan soils. These soils make up about 15 percent of this map unit. The Vanda soil is undulating and gently rolling and is strongly affected by sodium. It is on fans and foot slopes.

The Barkof soil is moderately deep and well drained. It formed in material that weathered from soft clayey shale; it is on the lower side slopes of knolls. Typically, the surface layer is dark grayish brown clay 7 inches thick. The subsoil is mostly grayish brown clay 21 inches thick. Below that, to a depth of 60 inches, there is platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Surface runoff is medium, and the hazard of erosion by wind and water is moderate. Platy shale is at a depth of 20 to 40 inches.

The Norbert soil is shallow and well drained. It formed in material that weathered from soft clayey shale; it is on knolls and low ridges. Typically, the surface layer is mostly olive gray clay 10 inches thick. The substratum is olive gray very shaly clay 4 inches thick. Below that, to a depth of 60 inches, there is soft platy shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is very low. The effective rooting depth is about 14 inches. The average annual wetting depth of the soil under native vegetation is 14 inches. Surface runoff is medium, and the hazard of erosion by wind and water is moderate. Platy shale is at a depth of 10 to 20 inches.

This map unit is not suited to cultivated crops because the Norbert soil is shallow to platy shale and has a very low available water capacity.

These soils are used as rangeland. The potential plant community on the Barkof soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Canby bluegrass, sedge decreasers, and forbs. The potential plant community on the Norbert soil consists mainly of bluebunch wheatgrass, western wheatgrass, green needlegrass, and winterfat. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease; western wheatgrass, Idaho fescue, fringed sagewort, common snowberry, and big sagebrush increase; and Kentucky bluegrass, timothy, annual grasses, rubber rabbitbrush, curlycup gumweed, and Hood phlox invade.

On the Barkof soil, the potential plant community produces 2,400 pounds of forage per acre in favorable years and 1,300 pounds per acre in unfavorable years. On the Norbert soil, forage production is 1,600 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The Norbert soil is not suitable for windbreaks because its available water capacity is very low, but the Barkof soil is suitable. It has a low available water capacity, which restricts the choice of trees and shrubs to those that are drought resistant. Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper are suitable trees. Siberian peashrub, sandcherry, and silver buffaloberry are suitable shrubs.

These soils are limited for most urban uses. Foundations and basements for houses require special design to overcome the limitations imposed by a high shrink-swell potential and low strength. Septic tank absorption fields require special design to overcome the limitations imposed by slow or very slow permeability and the shallowness or moderate depth to platy shale.

Capability subclass VIs, dryland. The Barkof soil is in Clayey range site, 15- to 19-inch precipitation zone; the Norbert soil is in Shallow Clay range site, 15- to 19-inch precipitation zone.

9—Barkof-Norbert clays, 8 to 20 percent slopes. This complex consists of Barkof and Norbert soils on uplands. The elevation is 2,500 to 4,400 feet. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Barkof soil makes up about 40 percent of the map unit, and the Norbert soil makes up about 40 percent. Included in mapping, and making up about 20 percent of this map unit, are small areas of Judith, Marvan, and Windham soils and some areas of shale outcrop. The shale outcrop is on hillsides and eroded areas along drainageways.

The Barkof soil is moderately deep and well drained. It formed in material that weathered from soft clayey shale; it is on the lower side slopes of hills. Typically, the surface layer is dark grayish brown clay 7 inches thick. The subsoil is mostly grayish brown clay 21 inches thick. Below that, to a depth of 60 inches, there is platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is low. The root zone extends to a depth of about 28 inches. The average annual wetting depth of the soil where it is under native vegetation is 28 inches. Surface runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Platy shale is at a depth of 20 to 40 inches.

The Norbert soil is shallow and well drained. It formed in material that weathered from soft clayey shale, and it is on the upper side slopes of the knolls, hills, and ridges. Typically, the surface layer is mostly olive gray clay 10 inches thick. The substratum is olive gray, very shaly clay 4 inches thick. Below that, to a depth of 60 inches, there is platy shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is very low. The root zone extends to a depth of about 14 inches. The average annual wetting depth of the soil where it is under native vegetation is 14 inches. Surface runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Platy shale is at a depth of 10 to 20 inches.

This map unit is not suited to cultivated crops because the Norbert soil is shallow to platy shale and its available water capacity is very low.

The soils in this map unit are used as rangeland. The potential plant community on the Barkof soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Canby bluegrass. Sedges and forbs are decreasers. The potential plant community on the Norbert soil consists mainly of bluebunch wheatgrass, western wheatgrass, green needlegrass, and winterfat. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease; western wheatgrass, Idaho fescue, fringed sagewort, common snowberry, and big sagebrush increase; and Kentucky bluegrass, timothy, annual grasses, rubber rabbitbrush, curlycup gumweed, and Hood phlox invade.

On the Barkof soil, the potential plant community produces 2,400 pounds of forage per acre in favorable years and 1,300 pounds per acre in unfavorable years. On the Norbert soil, forage production is 1,600 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The soils are suited to the use of machinery in preparing a seedbed and in planting. Minimum soil disturbance and planting across the slope help control runoff and water erosion. A permanent and adequately maintained cover of natural grasses also helps to control water erosion.

These soils are not suited to windbreaks. The Barkof soil has a low available water capacity, and the Norbert soil has a very low available water capacity and is shallow.

These soils are very poorly suited to timber production. There are, however, some ponderosa pine and limber pine of merchantable quality on north- and east-facing side slopes.

These soils are limited for most urban uses. Septic tank absorption fields require special design to overcome the limitations imposed by the slow and very slow permeability, the platy shale, and the slope. Foundations and basements for houses require special design to overcome the limitations imposed by the shrinking and swelling of the soils, the low strength of the soils, and the platy shale.

Capability subclass VIe, dryland. The Barkof soil is in Clayey range site, 15- to 19-inch precipitation zone; the Norbert soil is in Shallow Clay range site, 15- to 19-inch precipitation zone.

10—Barkof-Windham association, moderately steep. This association consists of Barkof soil below the edges of terraces and Windham soil on the edges of terraces on uplands. The elevation is 3,200 to 4,400 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Barkof soil makes up about 60 percent of the map unit, and the Windham soil makes up 25 percent. Included in mapping, and making up about 15 percent of the map unit, are small areas of Marvan and Norbert soils and shale outcrop. The shale outcrop is on the upper part of the side slopes below the edges of the terraces.

The Barkof soil is moderately deep and well drained. It formed in material weathered from soft clayey shale. Typically, the surface layer is dark grayish brown clay 7 inches thick. The subsoil is mostly grayish brown clay 21 inches thick. Below that, to a depth of 60 inches, there is platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 28 inches. Surface runoff is rapid. Wind erosion is a moderate hazard, and water

erosion is a severe hazard. Platy shale is at a depth of 20 to 40 inches.

The Windham soil is deep and well drained. It formed in alluvium. Typically, the surface layer is dark grayish brown gravelly loam 6 inches thick. The substratum, to a depth of 60 inches, or more, is pale brown very gravelly loam.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 30 inches. Surface runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. This soil is droughty because of the large amount of rock fragments in the profile.

The soils in this association are not suited to cultivated crops because of steep slopes and droughtiness.

A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

The soils are used as rangeland. The potential plant community consists mainly of rough fescue, western wheatgrass, bluebunch wheatgrass, and little bluestem. Some sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, rough fescue and bluebunch wheatgrass decrease; Idaho fescue, needleandthread, blue grama, prairie junegrass, big sagebrush, and threadleaf sedge increase; and clubmoss, annual grasses, Hood phlox, and pussytoes invade.

On the Barkof soil, the potential plant community produces 2,400 pounds of forage per acre in favorable years and 1,300 pounds per acre in unfavorable years. On the Windham soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The soils in this association are not suited to windbreaks because of slope.

The soils are very poorly suited to timber production. There are, however, a few ponderosa pine trees of merchantable quality on north- and east-facing side slopes.

These soils are limited for most urban uses by slope.

Capability subclass VIe, dryland. The Barkof soil is in Clayey range site, 15- to 19-inch precipitation zone; the Windham soil is in Thin Hilly range site, 15- to 19-inch precipitation zone.

11—Bascovy clay, 2 to 6 percent slopes. This soil is moderately deep and well drained. It formed on uplands in material that weathered from soft clayey shale. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is grayish brown clay 6 inches thick; it has a thin, light brownish gray, vesicular crust. The subsoil is olive gray clay 9 inches thick. The substratum is olive gray clay 8 inches thick. Below that, to a depth of 60 inches, there is olive gray and olive brown, soft clayey shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is low. The root zone extends to a depth of about 23 inches. The average annual wetting depth of the soil under native vegetation is 23 inches. Surface runoff is medium, and the hazard of erosion by wind and water is moderate. Soft clayey shale is at a depth of 20 to 40 inches.

Small areas of Dilts, Lisam, Marvan, and Vanda soils are included in mapping. Dilts and Lisam soils are gently sloping and moderately sloping; they are on small knolls and ridges. They are 10 to 20 inches deep to shale, and they are droughty. The Vanda soil is gently and moderately sloping; it is on foot slopes and fans. It is strongly sodium-affected and is subject to surface crusting if farmed. The crusting restricts seedling emergence and reduces crop yields. The Marvan soil is moderately sodium-affected.

The Bascovy soil is used mainly for range. In some areas it is used for dryland crops, mainly wheat and barley.

Droughtiness and erosion by wind and water are the main limitations in using this soil for cultivated crops. Because of droughtiness, successful crop production depends on a suitable distribution of rainfall during the growing season. Stripcropping, tall grass barriers for trapping windblown snow, minimum tillage, and stubble mulch tillage help to conserve moisture and control erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, thickspike wheatgrass, Canby bluegrass, Nuttall saltbush, and forbs. If the rangeland is overgrazed, western wheatgrass, green needlegrass, and Nuttall saltbush decrease; prairie junegrass and inland saltgrass increase; and foxtail barley, curlycup gumweed, plains pricklypear, and broom snakeweed invade.

The potential plant community produces 1,300 pounds per acre of forage in favorable years and 700 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil is suited to windbreaks. The low available water capacity restricts the choice of shrubs and trees to those that are drought resistant. Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper are suitable trees. Siberian peashrub, silver buffaloberry, and western sandcherry are suitable shrubs.

This soil is limited for most urban uses. Septic tank absorption fields require special design to overcome limitations imposed by the very slow permeability and the shallowness to shale. Foundations and basements for houses require special design to compensate for the high shrink-swell potential and low strength of the soil.

Capability subclass IVs, dryland; Clayey range site, 10- to 14-inch precipitation zone.

12—Bascovy-Lisam-Dilts clays, 2 to 8 percent slopes. This complex consists of undulating and gently rolling Bascovy soil and gently rolling Lisam and Dilts soils on uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Bascovy soil makes up about 40 percent of the map unit, the Lisam soil makes up 25 percent, and the Dilts soil makes up 25 percent. Included in mapping, and making up about 10 percent of the map unit, are small areas of Marvan and Vanda soils and shale outcrop.

The Bascovy soil is moderately deep and well drained. It formed on the lower slopes of knolls and ridges in material that weathered from soft clayey shale. Typically, the surface layer is grayish brown clay 6 inches thick; it has a thin, light brownish gray, vesicular crust. The subsoil is olive gray clay 9 inches thick. The substratum is olive gray clay 8 inches thick. Below that, to a depth of 60 inches, there is olive gray and olive brown, soft clayey shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 23 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 23 inches. Surface runoff is medium, and the hazard of erosion by wind and water is moderate. Soft clayey shale is at a depth of 20 to 40 inches.

The Lisam soil is shallow and well drained. It formed on the upper slopes of some knolls in material that weathered from soft clayey shale. Typically, the surface layer is grayish brown clay 6 inches thick. The upper part of the substratum is grayish brown clay 6 inches thick; the lower part is olive gray shaly clay 5 inches thick. Below that, to a depth of 60 inches, there is olive gray, soft, platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 17 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 17 inches. Surface runoff is medium, and the hazard of erosion by wind and water is moderate. Soft clayey shale is at a depth of 10 to 20 inches.

The Dilts soil is shallow and well drained. It formed on the upper slopes of some knolls in material that weathered from soft acid shale. Typically, the surface layer is grayish brown clay 3 inches thick; it has a thin, massive crust. The substratum is grayish brown clay 13 inches thick. Below that, to a depth of 60 inches, there is grayish brown, soft platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 16 inches. The average annual wetting depth of the soil under native vegetation is 16 inches. Surface runoff is medium, and the hazard of erosion by wind and water is moderate. Acid shales are at a depth of 10 to 20 inches.

This complex is not suited to cultivated crops because of the very low available water capacity of the Lisam and Dilts soils. It is suited to use as rangeland. The potential plant community on the Bascovy soil consists mainly of western wheatgrass, Nuttall alkaligrass, Nuttall saltbush, forbs, and greasewood. The potential plant community on the Lisam and Dilts soils consists mainly of bluebunch wheatgrass, western wheatgrass, green needlegrass, little bluestem, and winterfat. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass, western wheatgrass, green needlegrass, and Nuttall saltbush decrease; plains reedgrass, blue grama, onion, prairie junegrass, plains muhly, inland saltgrass, and big sage brush increase; and foxtail barley, greasewood, plains pricklypear, broom snakeweed, and curlycup gumweed invade.

On the Bascovy soil, the potential plant community produces 1,300 pounds of forage per acre in favorable years and 700 pounds per acre in unfavorable years. On the Lisam soil and on the Dilts soil, the forage production is 1,000 pounds per acre in favorable years and 500 pounds per acre in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The Lisam and Dilts soils are not suited to windbreaks because they have a very low available water capacity. The Bascovy soil is suited to windbreaks. Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper are suitable trees. Siberian peashrub, silver buffaloberry, and sandcherry are suitable shrubs.

The soils in this complex are limited for most urban uses. Septic tank absorption fields require special design to overcome the limitations imposed by the very slow permeability and soft shale bedrock. Foundations and basements for houses require special design to overcome the limitations imposed by the high shrink-swell potential and low strength of the soil and the platy shale.

Capability subclass VIs, dryland. The Bascovy soil is in Clayey range site, 10- to 14-inch precipitation zone; the Lisam and Dilts soils are in Shallow Clay range site, 10- to 14-inch precipitation zone.

13—Bearpaw clay loam, 0 to 4 percent slopes. This soil is deep and well drained. It formed in glacial till on glaciated uplands at an elevation of 2,600 to 3,800 feet. Slopes are mainly medium in length. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer, where mixed, is dark grayish brown clay loam to a depth of 7 inches. The subsoil is dark grayish brown and grayish brown clay loam 16 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under

native vegetation is 40 inches. Surface runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Dimmick, Nishon, Elloam, and Vida soils are included in mapping. Dimmick and Nishon soils are level or nearly level; they are in small enclosed basins that are subject to ponding. The Elloam soil is nearly level and undulating, and is in small, sparsely vegetated depressions. It is strongly sodium-affected. The Vida soil has undulating topography.

This soil is used mainly for dryland crops and range. The dryland crops are mainly wheat and barley. In some small areas the soil is used for irrigated alfalfa for hay.

Wind erosion is the main limitation to the use of this soil for cultivated crops. Stripcropping, mulch tillage, and leaving clods or ridges on the surface after tillage help control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Some sedges, woody plants, and forbs are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; Idaho fescue, needleandthread, western wheatgrass, prairie junegrass, fringed sagewort, common snowberry, and big sagebrush increase; and clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes invade.

The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years. This soil is suited to seeding.

Clubmoss is very competitive, and its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to windbreaks. Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir are suitable trees. Siberian peashrub, common chokecherry, American plum, Silver buffaloberry, and lilac are suitable shrubs.

This soil is limited for most urban uses. Septic tank absorption fields require special design to overcome the limitations imposed by the slow permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

14—Bearpaw-Elloam clay loams, 0 to 4 percent slopes. This complex consists of nearly level to undulating Bearpaw and Elloam soils on glaciated uplands. The elevation is 2,600 to 3,800 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Bearpaw soil makes up about 65 percent of this map unit, and the Elloam soil makes up 20 percent. Included in mapping are small areas of Dimmick, Nishon, and Vida soils, which make up about 15 percent of the unit. Dimmick and Nishon soils are level or nearly level. They are in small enclosed basins that are subject to ponding.

The Bearpaw soil is deep and well drained. It formed in glacial till. Typically, the surface layer is mixed to a depth of 7 inches and is dark grayish brown clay loam. The subsoil is dark grayish brown and grayish brown clay loam 16 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil where it is under native vegetation is 40 inches. Surface runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Elloam soil is deep and well drained. It formed in glacial till in sparsely vegetated small depressions. Typically, the surface layer, where mixed, is grayish brown clay loam 7 inches thick. The subsoil is grayish brown clay loam 10 inches thick. The substratum, to a depth of 62 inches or more, is grayish brown and olive clay loam.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil where it is under native vegetation is 28 inches. Surface runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. The Elloam soil has a subsoil that is moderately affected by sodium at a depth of about 3 inches.

The soils in this complex are used for range and dryland farming. Dryland crops are mainly wheat, barley, and oats. Wind erosion limits the use of these soils for cultivated crops. Furthermore, the Elloam soil is subject to crusting and is moderately affected by sodium.

Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue help control wind erosion.

On the Elloam soil, leaving clods on the surface and increasing the content of organic matter help reduce surface crusting and improve seedling emergence.

The soils in this complex are suited to use as rangeland. Most of the forage for grazing is produced on the Bearpaw soil. The potential plant community on the Bearpaw soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, and western wheatgrass; some sedges, forbs, and woody plants are decreasers. The potential plant community on the Elloam soil consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. Some forbs are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, Nuttall saltbush, and green needlegrass

decrease; Idaho fescue, needleandthread, prairie junegrass, inland saltgrass, fringed sagewort, and shrubby cinquefoil increase; and weedy plants such as clubmoss, Kentucky bluegrass, foxtail barley, greasewood, pussytoes, and pricklypear are likely to invade.

The potential plant community on the Bearpaw soil produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years. The potential plant community on the Elloam soil produces 900 pounds of forage per acre in favorable years and 400 pounds in unfavorable years.

Clubmoss is very competitive, and its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils are suited to seeding.

The soils in this complex are suited to windbreaks. For the Bearpaw soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. Because the Elloam soil is moderately affected by sodium, the choice of shrubs and trees is restricted to those that resist the effects of sodium. Suitable trees include Russian-olive and Siberian elm, and suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow and very slow permeability limits the soils for most urban uses. Septic tank absorption fields require special design to compensate for the permeability.

Capability subclass IIIe, dryland. Bearpaw soil: Silty range site, 15- to 19-inch precipitation zone; Elloam soil: Dense Clay range site, 15- to 19-inch precipitation zone.

15—Bearpaw-Elloam clay loams, 4 to 8 percent slopes. This complex consists of Bearpaw and Elloam soils on glaciated uplands. The elevation is 2,600 to 3,800 feet. The average annual precipitation is 15 inches, and the average annual air temperature is 42 degrees F. The average growing season is 110 days.

The Bearpaw soil makes up about 60 percent of this map unit, and the Elloam soil makes up 20 percent. Included with these soils in mapping are small areas of Dimmick, Nishon, Zahill, and Vida soils. These soils make up about 20 percent of the map unit. Dimmick and Nishon soils are level or nearly level; they are in small enclosed basins that are subject to ponding. The Zahill soil is gently rolling and strongly rolling on the top of knolls and ridges.

The Bearpaw soil is deep and well drained. It formed in glacial till on convex slopes. Typically, the surface layer, where mixed, is dark grayish brown clay loam to a depth of 7 inches. The subsoil is dark grayish brown and grayish brown clay loam 16 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 36 inches. Surface runoff is medium. Wind and water erosion are a moderate hazard.

The Elloam soil is deep and well drained. It formed in glacial till in small sparsely vegetated depressions. Typically, the surface layer, where mixed, is grayish brown clay loam to a depth of 7 inches. The subsoil is grayish brown clay loam 10 inches thick. The substratum, to a depth of 62 inches or more, is mostly grayish brown clay loam.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 28 inches. Surface runoff is medium. Wind and water erosion are a moderate hazard. The Elloam soil has a subsoil that is moderately affected by sodium at a depth of about 3 inches. This subsoil becomes very hard when dry and restricts the penetration of roots and moisture.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops, mainly wheat and barley.

Wind and water erosion limit the use of these soils for cultivated crops. Furthermore, the Elloam soil is subject to crusting. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue help control wind and water erosion. On the Elloam soil, roughening the surface and adding organic matter help to reduce surface crusting, increase water infiltration, and improve seedling emergence.

The soils are suited to use as rangeland. Most of the forage for grazing is produced on the Bearpaw soil. The potential plant community on the Bearpaw soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Some sedges, forbs, and woody plants are decreasers. The potential plant community on the Elloam soil consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. Some forbs are decreasers.

If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, Nuttall saltbush, and green needlegrass decrease; Idaho fescue, needleandthread, prairie junegrass, inland saltgrass, fringed sagewort, and shrubby cinquefoil increase; and weedy plants including clubmoss, Kentucky bluegrass, foxtail barley, greasewood, pussytoes, and plains pricklypear are likely to invade.

The potential plant community on the Bearpaw soil produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years. The potential plant community on the Elloam soil

produces 800 pounds of forage per acre in favorable years and 300 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to seeding.

The soils are suited to windbreaks. For the Bearpaw soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. Because the Elloam soil is moderately affected by sodium, the choice of shrubs and trees is restricted to those that resist the effects of sodium. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability of the Bearpaw soil and very slow permeability and low strength of the Elloam soil are limitations for most urban uses. Septic tank absorption fields require special design to compensate for the slow and very slow permeability.

Capability subclass IIIe, dryland. Bearpaw soil: Silty range site, 15- to 19-inch precipitation zone; Elloam soil: Dense Clay range site, 15- to 19-inch precipitation zone.

16—Bearpaw-Vida clay loams, 0 to 4 percent slopes. This complex consists of Bearpaw and Vida soils on glaciated uplands. The elevation is 2,600 to 3,800 feet. The average annual precipitation is 15 inches, and the mean annual temperature is 42 degrees F. The average growing season is 110 days.

The Bearpaw soil makes up about 55 percent of this map unit, and the Vida soil makes up 35 percent. Included in mapping are small areas of Dimmick, Nishon, and Elloam soils. These soils make up about 10 percent of the map unit. Dimmick and Nishon soils are nearly level; they are in small enclosed basins that are subject to ponding. The Elloam soil is in sparsely vegetated small depressions. Its subsoil is moderately affected by sodium and becomes very hard when dry.

The Bearpaw soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is mixed to a depth of 7 inches and is dark grayish brown clay loam. The subsoil is dark grayish brown and grayish brown clay loam 16 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Surface runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Vida soil is deep and well drained. It formed in glacial till on the upper part of slopes. Typically, the surface layer is mixed to a depth of 7 inches and is dark grayish brown clay loam. The subsoil is mostly brown clay loam 7 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Surface runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The soils in this complex are used for dryland crops, irrigated alfalfa for hay, and range. Dryland crops are mainly wheat and barley.

Wind erosion is the main limitation to using these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue help control wind erosion.

The soils are suited to use as rangeland. The potential plant community on the Bearpaw and Vida soils consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, basin wildrye, and Idaho fescue. Some sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease; and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes are likely to invade.

The potential plant community of Bearpaw and Vida soils produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and, thus, forage production increases.

The soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils are suited to windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for urban uses. Septic tank absorption fields require special design to compensate for the slow permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

17—Bearpaw-Vida clay loams, 4 to 8 percent slopes. This complex consists of Bearpaw and Vida soils on glaciated uplands. The elevation is 2,600 to

3,800 feet. The average annual precipitation is 15 inches, and the mean annual temperature is 42 degrees F. The average growing season is 110 days.

The Bearpaw soil makes up about 45 percent of this map unit, and the Vida soil makes up 40 percent. Included with these soils in mapping are small areas of Dimmick, Nishon, Elloam, and Zahill soils. These soils make up about 15 percent of the map unit. Dimmick and Nishon soils are nearly level or level. They are in enclosed basins that are subject to ponding. The Elloam soil is in sparsely vegetated small depressions. It is moderately affected by sodium. The Zahill soil is gently rolling on the top of knolls and ridges.

The Bearpaw soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer, where mixed, is dark grayish brown clay loam to a depth of 7 inches. The subsoil is dark grayish brown and grayish brown clay loam 16 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 36 inches. Surface runoff is moderate. Wind and water erosion are a moderate hazard.

The Vida soil is deep and well drained. It formed in glacial till on the upper part of slopes. Typically, the surface layer, where mixed, is dark grayish brown clay loam to a depth of 7 inches. The subsoil is mostly brown clay loam 7 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 34 inches. Surface runoff is medium. Wind and water erosion are a moderate hazard.

The soils of this complex are used for dryland crops, range, and irrigated alfalfa for hay. Dryland crops are mainly wheat and barley.

Wind and water erosion are the main limitations in using these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue help control wind and water erosion.

The soils are suited to use as rangeland. The potential plant community on the Bearpaw and Vida soils consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Some sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and big sagebrush increase; and clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes invade.

The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

The soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils are suited to windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design to compensate for the slow permeability.

Capability subclass IIIe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

18—Belain loam, 2 to 8 percent slopes. This is a moderately deep, well drained soil in the Bearpaw Mountains. It formed in material that weathered from hard igneous rock on uplands and mountains. The elevation is 3,000 to 6,000 feet. Slopes are mainly short. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam and gravelly loam 11 inches thick. The substratum is brown gravelly loam and very gravelly loam 13 inches thick. Igneous bedrock is at a depth of 28 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 28 inches. Surface runoff is medium. Wind and water erosion are a moderate hazard. The depth to hard igneous bedrock ranges from 20 to 40 inches.

Small areas of Castner and Hedoes soils are included with this soil in mapping. The Castner soil is shallow, moderately sloping, and on ridges.

The Belain soil is used mainly as rangeland, but in some areas it is used for dryland crops, mainly wheat and barley, or for irrigated crops. The main irrigated crop is alfalfa hay.

Droughtiness and wind and water erosion are the main limitations to using this soil for cultivated crops. Because of droughtiness, successful crop production depends on good distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall grass barriers for trapping windblown snow help to conserve moisture. Stripcropping, tall grass barriers, minimum tillage, and stubble mulch tillage help control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Some sedges, woody plants, and forbs are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease; Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase; and clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes invade.

The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil is suited to windbreaks. The low available water capacity of the soil, however, restricts the choice of trees and shrubs to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and western sandcherry.

Because of the hard igneous rock at a depth of 20 to 40 inches, this soil is limited for most urban uses. The hard bedrock imposes a serious limitation to the construction of houses with basements and to the design of sewage disposal systems.

Capability subclass IIIe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

19—Benz loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil. It formed in alluvium on fans and terraces in valleys and on uplands. The elevation is 2,300 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is grayish brown loam 3 inches thick. The substratum in the upper 10 inches is grayish brown loam. Below that, to a depth of 60 inches, it is mostly grayish brown loam and clay loam stratified with thin lenses of fine sandy loam.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil in those areas that are in native vegetation is 25 inches. Surface runoff is medium. Erosion by wind and water is a moderate hazard. This soil is strongly affected by sodium and is subject to surface crusting.

Small areas of Havre, Vanda, and Yamac soils are included with this soil in mapping.

The Benz soil is very poorly suited to cultivated crops because it is strongly affected by sodium. It is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, needleandthread, prairie junegrass, Sandberg bluegrass, inland saltgrass, Nuttall saltbush, and greasewood. Some forbs are decreasers. If the rangeland is overgrazed, western wheatgrass and Nuttall saltbush decrease; forbs, needleandthread, prairie junegrass, and inland saltgrass increase; and broom snakeweed, foxtail barley, and annual grasses invade.

The potential plant community produces 400 pounds of forage per acre in favorable years and 200 pounds per acre in unfavorable years.

This soil is not suited to windbreaks because it is strongly affected by sodium.

The slow permeability limits the use of this soil for most urban uses. Septic tank absorption fields require special design to overcome the limitations imposed by the slow permeability.

Capability subclass VIs, dryland; Saline Upland range site, 10- to 14-inch precipitation zone.

20—Bowdoin clay. This is a deep, moderately well drained, nearly level soil. It formed in alluvium on flood plains and terraces in valleys. The elevation is 2,300 to 2,500 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is gray clay 6 inches thick. The substratum in the upper 28 inches is gray clay, and below that, to a depth of 60 inches or more, it is grayish brown clay.

Permeability is very slow, and because the soil is affected by sodium the available water capacity is moderate. The root zone extends to a depth of about 60 inches. The average annual wetting depth of the soil where it is in native vegetation is 30 inches. Surface runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. The soil is subject to rare flooding.

Small areas of Harlem and Vanda soils are included with this soil in mapping.

Because it is clayey and strongly affected by sodium, this soil is very poorly suited to cultivation. It is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, and Nuttall saltbush decrease; prairie junegrass, silver sagebrush, Sandberg bluegrass, and inland saltgrass increase; and foxtail barley, curlycup gumweed, plains pricklypear, and broom snakeweed invade.

The potential plant community produces 800 pounds of forage per acre in favorable years and 300 pounds per acre in unfavorable years.

This soil is not suited to windbreaks because it is strongly affected by sodium.

This soil is subject to rare flooding, which imposes a very serious limitation for urban uses.

Capability subclass VIs, dryland; Dense Clay range site, 10- to 14-inch precipitation zone.

21—Cabba loam, 8 to 35 percent slopes. This is a shallow, well drained, strongly sloping to steep soil that formed in soft siltstone on uplands. The elevation ranges from 3,200 to 4,000 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the mean annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer is grayish brown loam 3 inches thick. The substratum is mostly olive loam in the upper 9 inches. Below that, to a depth of 60 inches, it is soft platy siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 12 inches. The average annual wetting depth of the soil where it is in native vegetation is 12 inches. Surface runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Soft sedimentary beds are at a depth of 10 to 20 inches. This soil is droughty.

Small areas of sandstone and shale outcrop and areas of Farnuf soil are included with this soil in mapping. Sandstone outcrop and shale outcrop are on knolls and steep slopes. The Farnuf soil is on fans and foot slopes. It is moderately sloping.

The Cabba soil is very poorly suited to cultivated crops because the available water capacity is very low, platy siltstone is at a depth of 10 to 20 inches, and water erosion is a severe hazard. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, Idaho fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Some sedges, woody plants, and forbs are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase; and clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes invade.

The potential plant community produces 1,200 pounds of forage per acre in favorable years and 700 per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed effectively by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is not suited to windbreaks because of its very low available water capacity and the shallowness to platy siltstone.

The platy siltstone and the slope are the main limitations to most urban uses.

Capability subclass VIs, dryland; Shallow range site, 15- to 19-inch precipitation zone.

22—Cabba-Rock outcrop complex, 25 to 75 percent slopes. This complex consists of steep Cabba soil and steep and very steep Rock outcrop on uplands. The elevation is 3,200 to 4,000 feet. The average annual precipitation is 14 inches, and the mean annual temperature is 43 degrees F. The average growing season is 110 days.

The Cabba soil makes up about 55 percent of the map unit, and Rock outcrop makes up 30 percent. Included in mapping are small areas of Castner, Farnuf, and Perma soils. These soils make up about 15 percent of the map unit.

The Cabba soil is shallow and well drained. It formed on the sides of hills and ridges in material that weathered from soft siltstone. Typically, the surface layer is grayish brown loam 3 inches thick. The substratum is mostly olive loam in the upper 9 inches. Below that, to a depth of 60 inches, it is soft platy siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is 12 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 12 inches. Surface runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Platy siltstone is at a depth of 10 to 20 inches.

Rock outcrop consists of ledges on hillsides and rims along ridgetops.

This complex is not suited to cultivated crops because of the steep and very steep slopes, the rock outcrop, and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This complex is suited to use as rangeland, although the steep and very steep slopes make grazing difficult for livestock. The potential plant community on the Cabba soil consists mainly of bluebunch wheatgrass, rough fescue, little bluestem, green needlegrass, Idaho fescue, and needleandthread. Forbs and woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass and rough fescue decrease, prairie junegrass, needleandthread, blue grama, and fringed sagewort increase, and annual grasses, broom snakeweed, and pussytoes invade. In some places, there are a few ponderosa pine and limber pine trees.

The potential plant community of the Cabba soil produces 1,200 pounds of forage per acre in favorable years and 700 pounds per acre in unfavorable years.

This complex is not suited to windbreaks because of the steep and very steep slopes.

The slopes and the rock outcrop are the main limitations to most urban uses.

Capability subclass VIIe, dryland. Cabba soil is in Shallow range site, 15- to 19-inch precipitation zone.

23—Cabba-Windham association, steep. This association consists of Cabba soil below the edge of terraces and Windham soil on the edge of outwash terraces on uplands in the southeastern part of the survey area. The elevation ranges from 3,200 to 4,500 feet. The average annual precipitation is 15 inches, and the mean annual temperature is 42 degrees F. The average growing season is 110 days.

The Cabba soil makes up about 55 percent of the map unit, and the Windham soil makes up 30 percent. Included in mapping, and making up about 15 percent of the map unit, are small areas of Judith, Farnuf, and Martinsdale soils and some areas of shale outcrop. The Judith, Farnuf, and Martinsdale soils are moderately sloping. The shale outcrop is along eroded drainageways; the slopes are steep or very steep.

The Cabba soil is shallow and well drained. It formed in material that weathered from soft siltstone. Typically, the surface layer is grayish brown loam 3 inches thick. The substratum is mostly olive loam in the upper 9 inches. Below that, to a depth of 60 inches, it is soft platy siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The root zone extends to a depth of 12 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 12 inches. Surface runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Soft sedimentary beds are at a depth ranging from 10 to 20 inches.

The Windham soil is deep and well drained. It formed in alluvium. Typically, the surface layer is dark grayish brown gravelly loam 6 inches thick. The substratum, to a depth of 60 inches, is pale brown very gravelly loam.

Permeability is moderate, and the available water capacity is low. The root zone extends to a depth of about 60 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 30 inches. Surface runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. This soil is droughty because of the large number of rock fragments in the profile.

The soils in this association are not suited to cultivated crops because of the steep slopes, droughtiness, and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

The soils are suited to use as rangeland. The potential plant community on the Cabba soil consists mainly of bluebunch wheatgrass, rough fescue, green needlegrass, and needleandthread. Forbs and woody plants are decreasers. The potential plant community on the Windham soil consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass and rough fescue decrease, needleandthread, blue grama, fringed sagewort, prairie junegrass, and threadleaf sedge increase, and clubmoss, annual grasses, Hood phlox, pussytoes, and broom snakeweed invade. The potential plant community of the Cabba soil produces 1,200 pounds of forage per acre in favorable years and 700 pounds per acre in unfavorable years. The potential plant community of the Windham soil produces 1,500 pounds of forage per acre in favorable years and 900 pounds per acre in unfavorable years.

Clubmoss is very competitive. Its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this association are not suited to windbreaks because of the steep slopes.

The steep slopes limit the soils for urban uses.

Capability subclass VIe, dryland. Cabba soil is in Shallow range site, 15- to 19-inch precipitation zone; Windham soil is in Thin Hilly range site, 15- to 19-inch precipitation zone.

24—Cabba-Zahill association, steep. This association consists of Cabba and Zahill soils on uplands. The elevation ranges from 3,200 to 4,000 feet. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Cabba soil makes up 50 percent of the map unit, and the Zahill soil makes up 35 percent. Included in mapping, and making up about 15 percent of the map unit, are small areas of shale outcrop and of Vida and Farnuf soils. The areas of shale outcrop are along drainageways and on the lower part of slopes. The areas are eroded.

The Cabba soil is shallow and well drained. It is on the lower part of slopes and formed in material that weathered from soft siltstone. Typically, the surface layer is grayish brown loam 3 inches thick. The substratum is olive loam in the upper 9 inches. Below that, to a depth of 60 inches, it is soft platy siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is 12 inches. The average annual wetting depth of the soil where it is under native vegetation is 12 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Soft sedimentary beds are at a depth of 10 to 20 inches.

The Zahill soil is deep and well drained. It formed in glacial till on the upper part of slopes. Typically, the surface layer, if mixed to a depth of 7 inches, is grayish brown clay loam. The substratum, to a depth of 60 inches or more, is grayish brown clay loam.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil where it is under native vegetation is 36 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The soils in this association are not suited to cultivated crops because of the steep slopes and the severe hazard of water erosion. Furthermore, the Cabba soil is shallow to bedrock. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

The soils in this association are suited to use as rangeland and are used as rangeland. The potential plant community on the Cabba soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and needleandthread. Forbs and some woody plants are decreasers. The potential plant community on the Zahill soil consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. Overgrazing results in a decrease of desirable plants, such as bluebunch wheatgrass and rough fescue, and an increase of needleandthread, blue grama, fringed sagewort, and prairie junegrass. Clubmoss, annual grasses, Hood phlox, pussytoes, and broom snakeweed are likely to invade.

On the Cabba soil, the potential plant community produces 1,200 pounds of forage per acre in favorable years and 700 pounds per acre in unfavorable years. On the Zahill soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

Clubmoss is very competitive. Its potential infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this association are not suited to windbreaks because of the steep slopes.

The steep slopes limit the soils for most urban uses.

Capability subclass VIe, dryland. Cabba soil is in Shallow range site, 15- to 19-inch precipitation zone; Zahill soil is in Thin Hilly range site, 15- to 19-inch precipitation zone.

25—Cabbart-Delpoint loams, 8 to 35 percent slopes. This complex consists of strongly sloping to steep Cabbart soil and strongly sloping Delpoint soil on uplands mainly in the southern part of the survey area. The elevation is 2,300 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Cabbart soil makes up about 55 percent of the map unit, and the Delpoint soil makes up 25 percent. Included with these soils in mapping, and making up about 20 percent of the map unit, are small areas of Riedel, Lisam, Marmarth, and Twilight soils and some areas of sandstone and shale outcrop.

The Cabbart soil is shallow and well drained. It formed in material that weathered from soft platy siltstone. Typically, the surface layer is grayish brown loam 4 inches thick. The substratum is grayish brown loam in the upper 8 inches. Below that, to a depth of 60 inches, it is soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 12 inches. The average annual wetting depth of the soil where it is under native vegetation is 12 inches. Runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth of soft sedimentary bedrock is 10 to 20 inches.

The Delpoint soil is moderately deep and well drained. It formed in material that weathered from soft siltstone. It is on broad ridges and foot slopes. Typically, the surface layer is dark brown loam 4 inches thick. The subsoil is grayish brown and light yellowish brown loam 12 inches thick. The substratum, to a depth of 32 inches, is light brownish gray clay loam. Below that, to a depth of 60 inches, it is soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is about 32 inches. The average annual wetting depth of the soil in areas where it is in native vegetation is 32 inches. Runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Soft sedimentary beds are at a depth of 20 to 40 inches.

The soils in this complex are not well suited to cultivated crops because of the steep slopes, the shallowness to bedrock, the severe hazard of water erosion, and the very low available water capacity of the Cabbart soil. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

The soils are suited to use as rangeland. Most of the forage is produced on the Delpoint soil.

The potential plant community on the Cabbart soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. The potential plant community on the Delpoint soil consists of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass, western wheatgrass, needleandthread, and green needlegrass decrease; blue

grama, prairie junegrass, and fringed sagewort increase; and needleleaf sedge, broom snakeweed, clubmoss, and annual grasses invade.

On the Cabbart soil, the potential plant community produces 800 pounds of forage per acre in favorable years and 400 pounds per acre in unfavorable years. On the Delpoint soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive. Its potential infestation is an especially serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

The soils are not suited to windbreaks because of the very low available water capacity and the shallowness of the Cabbart soil and because the slopes in most places are more than 15 percent.

The shallowness to the soft sedimentary beds and the slopes limit these soils for most urban uses.

Capability subclass VIe, dryland. Cabbart soil is in Shallow range site, 10- to 14-inch precipitation zone; Delpoint soil is in Silty range site, 10- to 14-inch precipitation zone.

26—Cabbart-Hillon association, steep. This association consists of Cabbart and Hillon soils on uplands. The elevation is 2,300 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Cabbart soil makes up about 55 percent of the map unit, and the Hillon soil makes up 30 percent. Included in mapping, and making up about 15 percent of the map unit, are small areas of Yamac and Kevin soils and areas of sandstone and shale outcrop.

The Cabbart soil is shallow and well drained. It is on the lower side slopes of hills. It formed in material that weathered from soft sedimentary beds. Typically, the surface layer is grayish brown loam 4 inches thick. The substratum is grayish brown loam in the upper 8 inches. Below that, to a depth of 60 inches, it is soft siltstone that rubs to loam, silt loam, and clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is 12 inches. The average annual wetting depth of the soil under native vegetation is 12 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Platy siltstone is at a depth of 10 to 20 inches.

The Hillon soil is deep and well drained. It formed in glacial till and is on upper side slopes and ridges. Typically, the surface layer is brown clay loam 4 inches thick. The substratum, to a depth of 60 inches, is grayish brown clay loam.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 26 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

The soils in this association are not suited to cultivated crops because of the steep slopes and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

The soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Hillon soil. The steep slopes make it difficult for livestock to fully utilize the forage.

The potential plant community on the Cabbart soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. The potential plant community on the Hillon soil consists mainly of western wheatgrass, bluebunch wheatgrass, needleandthread, green needlegrass, prairie sandreed, and winterfat. Some forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, needleandthread, and bluebunch wheatgrass decrease, blue grama, threadleaf sedge, prairie junegrass, and fringed sagewort increase and annual grasses, broom snakeweed, and needleleaf sedge invade.

On the Cabbart soil, the potential plant community produces 800 pounds of forage per acre in favorable years and 400 pounds per acre in unfavorable years. On the Hillon soil, forage production is 900 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The soils are not suited to windbreaks because of the steep slopes.

They are limited for most urban uses also because of the steep slopes.

Capability subclass VIe, dryland. Cabbart soil is in Shallow range site, 10- to 14-inch precipitation zone; Hillon soil is in Thin Hilly Range site, 10- to 14-inch precipitation zone.

27—Cabbart-Rock outcrop, shale complex, 25 to 60 percent slopes. This complex consists of steep and very steep Cabbart soils and Rock outcrop, shale. It is on uplands in the southern part of the survey area. The elevation is 2,300 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Cabbart soil makes up about 50 percent of the map unit, and Rock outcrop, shale, makes up about 30 percent. Included in mapping are small areas of Riedel, Delpoint, Lisam, and Twilight soils and outcrops of sandstone. These soils and the sandstone outcrops make up about 20 percent of the map unit.

The Cabbart soil is shallow and well drained. It formed on the upper part of slopes in material that weathered from soft siltstone. Typically, the surface layer is grayish brown loam 4 inches thick. The substratum is grayish brown loam in the upper 8 inches. Below that, to a depth of 60 inches, it is soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is 12 inches. The average annual wetting depth of the soil in areas that are in native vegetation is 12 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth to soft sedimentary beds is 10 to 20 inches.

Rock outcrop, shale, is mainly on the lower part of slopes and along drainageways.

This complex is not suited to cultivated crops because of the steep and very steep slopes, the shale outcrop, and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This complex is suited to use as rangeland and is used as rangeland, although steep and very steep slopes make grazing difficult for livestock. The potential plant community on the Cabbart soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, desirable plants such as prairie sandreed, bluebunch wheatgrass, western wheatgrass, and needleandthread decrease; blue grama, prairie junegrass, and fringed sagewort increase; and annual grasses, foxtail barley, needleleaf sedge, and broom snakeweed invade. In some places there are a few ponderosa pine and limber pine trees.

The potential plant community of the Cabbart soil produces 800 pounds of forage per acre in favorable years and 400 pounds per acre in unfavorable years.

This complex is not suited to windbreaks because of the steep and very steep slopes.

The slopes and the shale outcrop are the main limitations to most urban uses.

Capability subclass VIIe, dryland. Cabbart soil is in Shallow range site, 10- to 14-inch precipitation zone.

28—Cabbart-Yamac-Rock outcrop complex, 15 to 70 percent slopes. This complex consists of steep to very steep Cabbart soil, moderately steep Yamac soil, and Rock outcrop. It is on uplands in the southern part of the survey area. The elevation is 2,300 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Cabbart soil makes up about 40 percent of the map unit, the Yamac soil about 25 percent, and Rock outcrop about 25 percent. Included in mapping are small areas of Delpoint, Riedel, and Twilight soils. These soils make up about 10 percent of the map unit. The strongly rolling or hilly Delpoint, Riedel, and Twilight soils are on broad ridges, hills, and knolls.

The Cabbart soil is shallow and well drained. It formed on the upper part of ridges and hills in material that weathered from soft sedimentary beds. Typically, the surface layer is grayish brown loam 4 inches thick. The substratum is grayish brown loam in the upper 8 inches. Below that, to a depth of 60 inches, it is soft siltstone that rubs to loam, silt loam, and clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is 12 inches. The average annual wetting depth of the soil under native vegetation is 12 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth to soft sedimentary beds is 10 to 20 inches.

The Yamac soil is deep and well drained. It formed in alluvium on foot slopes and fans. Typically, the surface layer is grayish brown loam 4 inches thick. The subsoil is light olive brown loam 7 inches thick. The substratum to a depth of 60 inches is light brownish gray loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

Rock outcrop consists of ledges on hillsides and rims along ridgetops.

The soils in this complex are not suited to cultivated crops because of steep slopes and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

These soils are suited to use as rangeland and are used as rangeland. The steep and very steep slopes make grazing difficult for livestock. The potential plant community on the Cabbart soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. The potential plant community on the Yamac soil consists mainly of western wheatgrass, little bluestem, needleandthread, green needlegrass, and prairie sandreed. Some forbs are decreasers. If the rangeland is overgrazed, desirable plants such as bluebunch wheatgrass, western wheatgrass, needleandthread, and green needlegrass decrease, blue grama, threadleaf sedge, prairie junegrass, and fringed sagewort increase, and annual grasses, broom snakeweed, and needleleaf sedge are likely to invade. In places there are a few ponderosa pine and limber pine trees.

On the Cabbart soil, the potential plant community produces 800 pounds of forage per acre in favorable years and 400 pounds per acre in unfavorable years. On the Yamac soil, forage production is 1,100 pounds per acre in favorable years and 700 pounds per acre in unfavorable years.

This complex is not suited to windbreaks because of the slopes.

The slopes also are the main limitation to urban development.

Capability subclass VIIe, dryland. Cabbart soil is in Shallow range site, 10- to 14-inch precipitation zone; Yamac soil is in Thin Hilly range site, 10- to 14-inch precipitation zone.

29—Castner gravelly loam, 8 to 35 percent slopes. This is a shallow, well drained, strongly sloping to steep soil on uplands and mountains. It formed in material that weathered from hard sandstone or igneous rock. The elevation is 3,000 to 6,000 feet. Slopes are mainly long. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

Typically, the surface layer of this soil is dark grayish brown gravelly loam 6 inches thick. The substratum is brown very channery loam 7 inches thick. Below that, to a depth of 60 inches, there is hard sandstone or igneous rock.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 13 inches. The average annual wetting depth of the soil where it is in native vegetation is 13 inches. Runoff is medium. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth to hard bedrock is 10 to 20 inches.

Small areas of Belain and Perma soils and Rock outcrop are included with this soil in mapping.

This soil is not suited to cultivated crops because of shallowness to hard rock, the very low available water capacity, and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of bluebunch wheatgrass, rough fescue, green needlegrass, Idaho fescue, and needleandthread. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass, rough fescue, and green needlegrass decrease, and Idaho fescue, needleandthread, blue grama, and fringed sagewort increase. Weedy plants likely to invade are annual grasses, broom snakeweed, and pussytoes.

The potential plant community produces 1,200 pounds of forage per acre in favorable years and 700 pounds per acre in unfavorable years.

This soil is not suited to windbreaks because of its very low available water capacity.

Shallowness to hard rock and the slopes are the main limitations to most urban uses.

Capability subclass VIe, dryland; Shallow range site, 15- to 19-inch precipitation zone.

30—Castner-Perma-Rock outcrop complex, 25 to 70 percent slopes. This complex consists of steep to very steep Castner and Perma soils and Rock outcrop on uplands and mountains. The elevation is 3,000 to 6,000 feet. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

The Castner soil makes up about 35 percent of the map unit, the Perma soil makes up 35 percent, and Rock outcrop makes up 20 percent. Included in mapping and making up about 10 percent of the map unit are small areas of Belain and Hedoes soils and talus slopes. Talus slopes are very steep slopes in areas below the rock outcrops.

The Castner soil is shallow and well drained. It formed in material that weathered from hard sandstone or igneous bedrock. Typically, the surface layer is dark grayish brown gravelly loam 6 inches thick. The substratum is brown very channery loam 7 inches thick. Below that, to a depth of 60 inches, there is hard rock.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 13 inches. The average annual wetting depth of the soil under native vegetation is 13 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Bedrock is at a depth of 10 to 20 inches.

The Perma soil is deep and well drained. It formed on the lower part of slopes in colluvium and alluvium derived from igneous rock and hard sandstone. Typically, the surface layer consists of 5 inches of very dark grayish brown gravelly loam and 6 inches of dark grayish brown very gravelly loam. The subsoil is brown very gravelly loam 29 inches thick. The substratum, to a depth of 60 inches, is grayish brown very gravelly loam.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

Rock outcrop is on the top of ridges, hills, and mountains.

This complex is not suited to cultivated crops because of the steep and very steep slopes. It is suited to use as rangeland, although the slopes make grazing difficult for livestock. The potential plant community on the Castner soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, and needleandthread. Some forbs and woody plants are decreasers. The potential plant community on the Perma soil consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and little bluestem decrease; Idaho fescue, Woods rose, common snowberry, common chokecherry, needleandthread, blue grama, prairie junegrass, and fringed sagewort increase; and annual grasses, Kentucky bluegrass, broom snakeweed, and pussytoes invade.

On the Castner soil, the potential plant community produces 1,200 pounds of forage per acre in favorable

years and 700 pounds per acre in unfavorable years. On the Perma soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The soils are very poorly suited to timber production. There are, however, a few ponderosa pine and Douglas-fir trees of merchantable quality on north-facing slopes.

The soils in this complex are not suited to windbreaks because of the steep and very steep slopes.

The slopes are the main limitation to most urban uses.

Capability subclass VIIe, dryland. Castner soil is in Shallow range site, 15- to 19-inch precipitation zone; Perma soil is in Thin Hilly range site, 15- to 19-inch precipitation zone.

31—Chinook fine sandy loam, 2 to 6 percent slopes. This is a deep, well drained, undulating to gently rolling soil on glaciated uplands. It formed in alluvial and eolian material. The elevation is 2,500 to 3,500 feet. Slopes are mainly short. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown fine sandy loam 6 inches thick. The subsoil is brown fine sandy loam 10 inches thick. The substratum, to a depth of 60 inches or more, is mostly grayish brown fine sandy loam.

Permeability is moderately rapid, and the available water capacity is moderate or high. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a severe hazard.

Small areas of Elloam and Kevin soils are included with this soil in mapping. The sodium-affected Elloam soil is in small depressions.

The Chinook soil is used mainly as rangeland. In some small areas it is used for dryland crops, mainly wheat, barley, and oats.

The hazard of wind erosion limits the use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or natural vegetation also helps to control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, needleandthread, and western wheatgrass. Some forbs are decreasers. If the rangeland is overgrazed, Indian ricegrass, prairie sandreed, and western wheatgrass decrease, needleandthread, blue grama, and fringed sagewort increase, and annual grasses and plains pricklypear invade.

The potential plant community produces 1,600 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses.

Capability subclass IVe, dryland; Sandy range site, 10- to 14-inch precipitation zone.

32—Chinook fine sandy loam, 6 to 12 percent slopes. This is a deep, well drained, gently rolling to strongly rolling soil. It formed in alluvial and eolian material on glaciated uplands. The elevation is 2,500 to 3,500 feet. Slopes are mainly short. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown fine sandy loam 6 inches thick. The subsoil is brown fine sandy loam 10 inches thick. The substratum, to a depth of 60 inches or more, is mostly grayish brown fine sandy loam.

Permeability is moderately rapid, and the available water capacity is moderate or high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a severe hazard.

Small areas of Elloam and Kevin soils are included with this soil in mapping. The sodium-affected Elloam soil is in sparsely vegetated small depressions.

The Chinook soil is used mainly as rangeland. In some small areas it is used for dryland crops, mainly wheat, barley, and oats.

The hazard of wind erosion limits the use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that uses crop residue can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or natural vegetation also helps to control wind erosion.

This soil is well suited to use as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, needleandthread, and western wheatgrass. Some forbs are decreasers. If the rangeland is overgrazed, Indian ricegrass, prairie sandreed, and western wheatgrass decrease; needleandthread, blue grama, and fringed sagewort increase; and annual grasses and plains pricklypear invade.

The potential plant community produces 1,600 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses.

Capability subclass IVe, dryland; Sandy range site, 10- to 14-inch precipitation zone.

33—Chinook-Phillips complex, 2 to 6 percent slopes. This complex consists of undulating to gently rolling Chinook and Phillips soils on glaciated uplands. The elevation is 2,500 to 3,500 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Chinook soil makes up about 50 percent of this map unit, and the Phillips soil makes up 30 percent. Included with these soils in mapping are small areas of Lihen, Elloam, and Thoeny soils. These soils make up about 20 percent of the map unit. The undulating and gently rolling Lihen soil is on the top of ridges and knolls. The sodium-affected Elloam and the Thoeny soils are in depressions.

The Chinook soil is deep and well drained. It formed in alluvium and eolian material on knolls and ridges. Typically, the surface layer is grayish brown fine sandy loam 6 inches thick. The subsoil is brown fine sandy loam 10 inches thick. The substratum, to a depth of 60 inches, is mostly grayish brown fine sandy loam.

Permeability is moderately rapid, and the available water capacity is moderate or high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a severe hazard.

The Phillips soil is deep and well drained. It formed in glacial till on uplands. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is mostly light brownish gray loam 5 inches thick. The upper part of the subsoil is brown clay 3 inches thick. The lower part is mostly grayish brown clay loam 12 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The soils in this complex are used mainly as rangeland. In some small areas they are used for dryland crops, mainly wheat, barley, and oats.

Wind and water erosion limit the use of these soils for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind and water erosion. A permanent and adequately maintained cover of planted grasses or natural vegetation also helps to control wind and water erosion.

The soils in this complex are well suited to use as rangeland and are used as rangeland. The potential plant community on the Chinook soil consists mainly of Indian ricegrass, prairie sandreed, green needlegrass, needleandthread, and western wheatgrass. Some forbs are decreasers. The potential plant community on the Phillips soil consists mainly of western wheatgrass, prairie junegrass, Sandberg bluegrass, prairie sandreed, and Nuttall saltbush. Some woody plants are decreasers. If the rangeland is overgrazed, Indian ricegrass, prairie sandreed, western wheatgrass, and green needlegrass decrease; needleandthread, blue grama, and fringed sagewort increase; and annual grasses, clubmoss, broom snakeweed, and plains pricklypear invade.

On the Chinook soil, the potential plant community produces 1,600 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Phillips soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils can be used for windbreaks. On the Chinook soil, suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry. On the Phillips soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry.

Slow permeability limits the Phillips soil for most urban uses. Septic tank absorption fields on this soil require special design because of the slow permeability. The Chinook soil is suited to most urban uses.

Capability subclass IVe, dryland. Chinook soil is in Sandy range site, 10- to 14-inch precipitation zone; Phillips soil is in Silty range site, 10- to 14-inch precipitation zone.

34—Cozberg fine sandy loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil that formed in alluvial and eolian material on glaciated uplands. The elevation is 2,500 to 3,500 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is brown fine sandy loam 7 inches thick. The subsoil is brown fine sandy loam 19 inches thick. The substratum, to a depth of 60 inches, is mostly pale brown loamy sand.

Permeability is moderately rapid to a depth of about 26 inches and is rapid below that. The available water capacity is moderate. The effective rooting depth is about 30 inches. The average annual wetting depth of this soil where it is in native vegetation is about 36 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard. This soil is droughty.

Small areas of Assinniboine, Chinook, and Wabek soils are included in mapping. The gently sloping Wabek soil is on mounds.

The Cozberg soil is used mainly as rangeland. In some small areas it is used for dryland crops, mainly wheat, barley, and oats.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps to control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, needleandthread, and western wheatgrass. Some forbs are decreasers. If there is continued excessive grazing, desirable plants such as Indian ricegrass and prairie sandreed decrease and needleandthread, blue grama, and fringed sagewort increase. Weedy plants, including annual grasses, are likely to invade.

The potential plant community produces 1,600 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses. Because of the rapid permeability of the substratum, underground water supplies can be polluted by liquid and solid waste from disposal systems.

Capability subclass IVe, dryland; Sandy range site, 10- to 14-inch precipitation zone.

35—Creed loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to undulating soil that formed in alluvium on fans and terraces on uplands. The elevation is 2,400 and 3,800 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is light brownish gray and light gray loam 6 inches thick. The upper part of the subsoil is grayish brown silty clay loam 6 inches thick. The lower part is light brownish gray silty clay loam 4 inches thick. The substratum, to a depth of 60 inches, is light brownish gray silty clay loam in the upper part and light brownish gray and light yellowish brown silty clay loam in the lower part. It has thin strata of loam in the lower part.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The subsoil is slightly affected by sodium at a depth of about 6 inches. It is very hard when dry, impeding the penetration of roots and moisture.

Small areas of Gerdrum, Nobe, and Ethridge soils are included with this soil in mapping. The Gerdrum soil is nearly level and is moderately affected by sodium. It is in small depressions. The Nobe soil is nearly level and gently sloping and is strongly affected by sodium. It is in barren or nearly barren shallow depressions.

This soil is used mainly as rangeland. In some areas it is used for dryland crops, including wheat, oats, and barley, but yields are low because the soil is slightly affected by sodium. Wind erosion is also a limitation. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Some forbs are decreasers. Continued excessive grazing results in a decrease of western wheatgrass and green needlegrass and an increase of needleandthread, blue grama, and fringed sagewort. Furthermore, annual grasses, broom snakeweed, and clubmoss are likely to invade.

The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Because this soil is slightly affected by sodium, the choice of shrubs and trees is restricted to those that are resistant to sodium salts. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

Slow permeability limits this soil for most urban uses. Septic tank absorption fields on this soil require special design because of the slow permeability.

Capability subclass IVs, dryland; Silty range site, 10- to 14-inch precipitation zone.

36—Creed-Gerdrum complex, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping Creed and Gerdrum soils on fans and terraces on uplands. The soils formed in alluvium. The elevation is 2,400 to 3,800 feet. The average annual precipitation is 12 inches, and the mean annual temperature is 43 degrees F. The average growing season is 115 days.

The Creed soil makes up about 60 percent of the map unit, and the Gerdrum soil makes up 30 percent. Included with these soils in mapping are small areas of Benz, Ethridge, Marvan, and Nobe soils. These soils make up about 10 percent of the map unit. Benz and Nobe soils are strongly affected by sodium.

The Creed soil is deep and well drained. Typically, the surface layer is light brownish gray and light gray loam 6 inches thick. The upper part of the subsoil is mostly grayish brown silty clay loam 6 inches thick. The lower part is light brownish gray silty clay loam 4 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray silty clay loam in the upper part and light brownish gray and light yellowish brown silty clay loam in the lower part. It has thin strata of loam in the lower part.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil is slightly affected by sodium at a depth of about 6 inches. It is very hard when dry, and it impedes the penetration of roots and moisture.

The Gerdrum soil is deep and well drained. It formed in alluvium in sparsely vegetated small depressions. Typically, the surface layer, where mixed, is grayish brown clay loam 7 inches thick. The upper part of the subsoil is mostly grayish brown clay 15 inches thick. The lower part is light brownish gray clay loam 14 inches thick. The substratum to a depth of 60 inches is grayish brown sandy clay loam and brown gravelly sandy loam.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil is moderately affected by sodium. If this soil is cultivated, the subsoil becomes very hard when dry, and it restricts the movement of roots and moisture. In cultivation, the surface layer and upper part of the subsoil are mixed, and the crusting that results reduces seedling emergence and crop yields.

The soils in this complex are used mainly as rangeland. In some small areas they are used for dryland crops, mainly wheat, barley, and oats. Wind erosion and surface crusting are the main limitations to use of the soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. Applications of manure or other organic matter help reduce surface crusting and increase crop yields.

The soils in this complex are suited to use as rangeland. Most of the forage is produced by the Creed soil. The potential plant community on the Creed soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Some forbs are decreasers. The potential plant community on the Gerdrum soil consists of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. Some forbs are decreasers. Continued excessive grazing results in a decrease of desirable plants, including western wheatgrass, green needlegrass, and Nuttall saltbush, and an increase of needleandthread, blue grama, fringed sagewort, prairie junegrass, and shrubby cinquefoil. Furthermore, weedy plants, including annual grasses, broom snakeweed, plains pricklypear, and clubmoss, are likely to invade.

On the Creed soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Gerdrum soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. Because the soils are affected by sodium, the choice of shrubs and trees is restricted to those that are resistant to sodium. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

Slow permeability limits the soils for most urban uses. Septic tank absorption fields on these soils require special design because of the slow permeability. The Gerdrum soil has low strength and high shrink-swell potential. Consequently, basements and foundations for buildings on this soil require special design.

Capability subclass IVs, dryland. Creed soil is in Silty range site, 10- to 14-inch precipitation zone; Gerdrum soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

37—Delpoint loam, 2 to 4 percent slopes. This is a moderately deep, well drained soil on uplands. It formed

in material that weathered from soft siltstone. The elevation is 2,300 to 3,800 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is dark brown loam 4 inches thick. The upper part of the subsoil is grayish brown loam 4 inches thick, and the lower part is light yellowish brown loam 8 inches thick. The substratum is light brownish gray clay loam 16 inches thick, and below that, to a depth of 60 inches, it is soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is about 32 inches. The average annual wetting depth of the soil under native vegetation is 32 inches. Runoff is slow. Wind erosion is a moderate hazard. The depth to soft siltstone ranges from 20 to 40 inches.

Small areas of Cabbart, Riedel, and Twilight soils are included with this soil in mapping. The moderately sloping, shallow Cabbart soils and the moderately deep Riedel soils are on knolls. The gently sloping Twilight soils are on the lower part of slopes.

This Delpoint soil is used mainly as rangeland. In some areas it is used for dryland crops, mainly wheat, barley, and oats. Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can help control wind erosion. A permanent and adequately maintained cover of planted grasses or natural vegetation also helps to control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Some forbs are decreasers. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease; prairie junegrass, needleandthread, blue grama, threadleaf sedge, and fringed sagewort increase; and annual grasses, clubmoss, and broom snakeweed invade.

The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks, but the moderate available water capacity and the siltstone beds restrict the choice of shrubs and trees. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

Because of the 20- to 40-inch depth to soft sedimentary bedrock, this soil is limited for most urban uses. Septic tank absorption fields require special design.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

38—Delpoint-Cabbart loams, 2 to 8 percent slopes. This complex consists of undulating to gently rolling Delpoint and Cabbart soils on uplands. The elevation is 2,300 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Delpoint soil makes up about 45 percent of the map unit, and the Cabbart soil makes up 35 percent. Included in mapping are small areas of Riedel, Marmarth, and Twilight soils. These soils make up about 20 percent of the map unit. The Riedel soil is on the top of knolls and ridges. It is undulating to gently rolling. Marmarth and Twilight soils are on lower slopes. They are undulating.

The Delpoint soil is moderately deep and well drained. It formed on the lower part of slopes in material that weathered from soft siltstone. Typically, the surface layer is dark brown loam 4 inches thick. The upper part of the subsoil is grayish brown loam 4 inches thick. The lower part is light yellowish brown loam 8 inches thick. The substratum is light brownish gray clay loam, 16 inches thick, and below that, to a depth of 60 inches, soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is about 32 inches. The average annual wetting depth of the soil under native vegetation is 32 inches. Runoff is medium. Wind and water erosion are moderate hazards. The depth to soft siltstone ranges from 20 to 40 inches.

The Cabbart soil is shallow and well drained. It formed in material that weathered from soft siltstone. Typically, the surface layer is grayish brown loam 4 inches thick. The substratum is grayish brown loam 8 inches thick, and, below that, to a depth of 60 inches, there is soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 12 inches. The average annual wetting depth of the soil under native vegetation is 12 inches. Runoff is medium. Wind and water erosion are moderate hazards. The depth to soft siltstone ranges from 10 to 20 inches.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops, mainly wheat, barley, and oats. Wind and water erosion are the main limitations to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop

residue, contour stripcropping, and grassed waterways help control wind erosion.

These soils are suited to use as rangeland. Most of the forage is produced on the Delpoint soil. The potential plant community on the Delpoint soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Some forbs are decreasers. The potential plant community on the Cabbart soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Some forbs and woody plants are decreasers. If there is continued excessive grazing, the desirable plants such as green needlegrass, western wheatgrass, bluebunch wheatgrass, and needleandthread decrease; and blue grama, threadleaf sedge, fringed sagewort, and prairie junegrass increase; and annual grasses, broom snakeweed, and other weedy plants are likely to invade.

On the Delpoint soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Cabbart soil, forage production is 800 pounds per acre in favorable years and 400 pounds per acre in unfavorable years.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks, but the choice of shrubs and trees is restricted. Suitable trees on the Delpoint soil include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry. Suitable trees on the Cabbart soil include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The soft sedimentary beds at a depth of 10 to 20 inches in the Cabbart soil and 20 to 40 inches in the Delpoint soil are limitations for most urban uses. Basements and foundations and septic tank absorption fields on these soils require special design.

Capability subclass IVe, dryland. Delpoint soil is in Silty range site, 10- to 14-inch precipitation zone; Cabbart soil is in Shallow range site, 10- to 14-inch precipitation zone.

39—Dimmick clay. This is a deep, very poorly drained, nearly level soil. It formed in clayey alluvium in undrained basins on glaciated uplands. The elevation is 2,500 to 3,800 feet. Slopes are 0 to 1 percent and are mainly medium in length. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is gray clay 22 inches thick. It is overlain by a layer of partly decomposed plant litter. The substratum, to a depth of 60 inches, is gray clay.

Permeability is very slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 60 inches. Runoff is very slow. Wind and water erosion are slight hazards. This soil is subject to frequent flooding in spring. The water table is within 3 feet of the surface in winter and in spring.

Small areas of Nishon soil are included with this soil in mapping.

The Dimmick soil is used mainly as rangeland. Ponding during the growing season makes this soil unsuited to cultivated crops.

This soil is suited to use as rangeland. The potential plant community consists mainly of prairie cordgrass, tall reedgrass, tufted hairgrass, and tall sedges. Forbs, sedges, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as prairie cordgrass, tall reedgrass, and tufted hairgrass and an increase of Baltic rush, forbs, woody plants, foxtail barley, and Rocky Mountain iris. The potential plant community produces 5,000 pounds of forage per acre in favorable years and 3,000 pounds per acre in unfavorable years.

This soil is not suitable for windbreaks because it is very poorly drained.

Wetness and flooding limit this soil for most urban uses.

Capability subclass Vw, dryland; Wetland range site, 10- to 14-inch precipitation zone.

40—Elloam clay loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil on uplands. It formed in glacial till. The elevation is 2,300 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil, if mixed to a depth of 7 inches, is light brownish gray clay loam. The subsoil is grayish brown clay loam 10 inches thick. The substratum is grayish brown and olive clay loam to a depth of 60 inches.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil is moderately affected by sodium. This soil is subject to surface crusting, which reduces seedling emergence and crop yields.

Small areas of Thoeny, Nobe, and Phillips soils are included with this soil in mapping. The Thoeny soil is at the head of drainageways and in vegetated depressions. The Nobe soil, which is strongly affected by sodium, is in depressions.

The Elloam soil is used mainly as rangeland. In a few small areas it is used for dryland crops, mainly wheat,

barley, and oats. Wind erosion and surface crusting are the main limitations to use of this soil for cultivated crops. Applications of manure or other organic matter reduce surface crusting and increase crop yields. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, forbs, and greasewood. If there is continued excessive grazing, desirable plants such as western wheatgrass, green needlegrass, and Nuttall saltbush decrease and plants such as prairie junegrass and inland saltgrass increase. Weedy plants likely to invade are foxtail barley, curlycup gumweed, plains pricklypear, broom snakeweed, and clubmoss. The potential plant community produces 800 pounds of forage per acre in favorable years and 300 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Because it is moderately affected by sodium, the choice of shrubs and trees is restricted. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The very slow permeability and low soil strength limit this soil for most urban uses. Septic tank absorption fields require special design because of the very slow permeability. Basements and foundations need special design because of the low strength.

Capability subclass IVs, dryland; Dense Clay range site, 10- to 14-inch precipitation zone.

41—Ethridge silty clay loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil on fans and stream terraces on uplands. It formed in alluvium. The elevation is 2,300 to 3,600 feet. Slopes are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown silty clay loam 6 inches thick. The subsoil is dark brown and grayish brown silty clay 14 inches thick. The substratum, to a depth of 60 inches, is grayish brown silty clay loam.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Gerdrum, Vanda, and Marvan soils are included with this soil in mapping. The nearly level Gerdrum and Vanda soils are in shallow, sparsely vegetated depressions. The Gerdrum soil is moderately affected by sodium, and the Vanda soil is strongly affected by sodium. These soils have a subsoil that is very hard when dry. The hard subsoil restricts the penetration of roots and moisture. If these soils are cultivated, the mixing of the surface layer and the upper part of the subsoil causes surface crusting, which reduces seedling emergence and crop yields. Applications of manure or other organic matter reduce surface crusting and increase crop yields.

The Ethridge soil is used mainly for dryland crops and irrigated alfalfa and as rangeland. Dryland crops are mainly wheat, barley, and oats. Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of plants such as needleandthread, blue grama, and fringed sagewort. Weedy plants likely to invade are annual grasses, broom snakeweed, and clubmoss. The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability, shrink-swell potential, and low soil strength limit the soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability. Basements and foundations for buildings require special design because of the shrink-swell potential and low soil strength.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 10- to 14-inch precipitation zone.

42—Ethridge-Gerdrum complex, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping soils on fans and stream terraces on uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Ethridge soil makes up about 60 percent of this map unit, and the Gerdrum soil makes up 25 percent. Included with these soils in mapping are small areas of Nobe, Harlem, and Marvan soils. These soils make up about 15 percent of the map unit. The nearly level or gently sloping Nobe soil is in small barren areas. It is strongly affected by sodium.

The Ethridge soil is deep and well drained. It formed in alluvium in smooth areas. Typically, the surface layer is grayish brown silty clay loam 6 inches thick. The subsoil is dark brown and grayish brown silty clay 14 inches thick. The substratum, to a depth of 60 inches, is grayish brown silty clay loam.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Gerdrum soil is deep and well drained. It formed in alluvium in sparsely vegetated small depressions. Typically, the surface layer, where mixed, is grayish brown clay loam to a depth of 7 inches. The upper part of the subsoil is mostly grayish brown clay 15 inches thick. The lower part is light brownish gray clay loam 14 inches thick. The substratum, to a depth of 60 inches, is grayish brown sandy clay loam and brown gravelly sandy loam.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil is moderately affected by sodium. It is very hard when dry; thus, the movement of roots and moisture is restricted. If this soil is cultivated, the surface layer and the upper part of the subsoil are mixed. This mixing results in surface crusting, which impedes seedling emergence, and thus crop yields are reduced.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops, mainly wheat, barley, and oats.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. On the Gerdrum soil, applications of manure or other organic matter are needed to reduce surface crusting and thus increase crop yields.

This complex is suited to use as rangeland. Most of the forage is produced on the Ethridge soil. The potential plant community on the Ethridge soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. The potential plant community on the Gerdrum soil consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, forbs, and greasewood. If the rangeland is overgrazed, desirable plants such as western wheatgrass and green needlegrass decrease and needleandthread, blue grama, fringed sagewort, prairie junegrass, and shrubby cinquefoil increase. Annual grasses, clubmoss, broom snakeweed, and plains pricklypear are likely to invade.

On the Ethridge soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds in unfavorable years. On the Gerdrum soil, forage production is 800 pounds per acre in favorable years and 300 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Because the Gerdrum soil is moderately affected by sodium, shrubs and trees are restricted to those that are resistant to sodium salts. Suitable trees on the Ethridge soil include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. On the Gerdrum soil, suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability and low soil strength of the Ethridge soil and the slow permeability, low strength, and high shrink-swell potential of the Gerdrum soil are limitations for most urban uses. Septic tank absorption fields require special design because of the slow permeability. Basements and foundations require special design because of the high shrink-swell potential and low soil strength.

Capability subclass IIIs, dryland. Ethridge soil is in Silty range site, 10- to 14-inch precipitation zone; and Gerdrum soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

43—Farnuf loam, 0 to 2 percent slopes. This is a deep, well drained soil on fans and stream terraces on uplands. It formed in alluvium. The elevation is 2,500 to 4,500 feet. Slopes are mainly short. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is dark grayish brown loam 5 inches thick. The subsoil is mostly dark brown and brown clay loam 19 inches thick. The substratum is pale brown clay loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Martinsdale, Shawmut, and Straw soils are included with this soil in mapping.

This soil is used for dryland and irrigated crops and as rangeland. The main dryland crops are wheat, barley, and oats. The main irrigated crops are wheat, barley, oats, alfalfa for hay, and corn for silage.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds per acre in unfavorable years.

Clubmoss is very competitive and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderate permeability and low soil strength limit this soil for most urban uses. Septic tank absorption fields require special design because of the moderate permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

44—Farnuf loam, 2 to 4 percent slopes. This is a deep, well drained soil on fans and stream terraces on uplands. It formed in alluvium. The elevation is 2,500 to 4,000 feet. Slopes are mainly short. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is dark grayish brown loam 5 inches thick. The subsoil is mostly dark brown and brown clay loam 19 inches thick. The substratum is pale brown clay loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Shawmut, Martinsdale, and Straw soils are included with this soil in mapping.

This soil is used for dryland and irrigated crops and as rangeland. The main dryland crops are wheat, barley, and oats. The main irrigated crops are wheat, barley, oats, alfalfa for hay, and corn for silage.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plan competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderate permeability and low soil strength limit this soil for most urban uses. Septic tank absorption fields require special design because of the moderate permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

45—Farnuf loam, 4 to 8 percent slopes. This is a deep, well drained soil on fans and stream terraces on uplands. It formed in alluvium. The elevation is 2,500 to 4,500 feet. Slopes are mainly short. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is dark grayish brown loam 5 inches thick. The subsoil is mostly dark brown and brown clay loam 19 inches thick. The substratum is pale brown clay loam to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

Small areas of Shawmut and Martinsdale soils are included with this soil in mapping.

The Farnuf soil is used for dryland crops, irrigated alfalfa hay, and as rangeland. The main dryland crops are wheat, barley, and oats.

Wind and water erosion are the main limitations to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

The soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderate permeability and low soil strength limit this soil for most urban uses. Septic tank absorption fields require special design because of the moderate permeability.

Capability subclass IIIe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

46—Gerdrum clay loam, 0 to 4 percent slopes. This is a deep, well drained soil on fans and terraces on uplands. It formed in alluvium. The elevation is 2,300 to 3,600 feet. Slopes are mainly short. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer, if mixed to a depth of 7 inches, is grayish brown clay loam. The subsoil, to a depth of 22 inches, is mostly grayish brown clay, and below that, to a depth of 36 inches, it is light brownish gray clay loam. The substratum is grayish brown sandy clay loam and brown gravelly sandy loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is about 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil is moderately affected by sodium. It is very hard when dry and restricts the movement of roots and moisture. When this soil is cultivated, the surface layer and the upper part of the subsoil are mixed, and a crust forms on the surface which reduces seedling emergence and crop yields.

Included with this soil in mapping are small areas of Thoeny and Vanda soils. The Vanda soil is nearly level to gently sloping and is strongly affected by sodium. It is in sparsely vegetated areas.

This soil is used mainly as rangeland. In some small areas it is used for dryland crops. The main dryland crops are wheat and barley.

Wind erosion and surface crusting are the main limitations to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residues can effectively control wind erosion. Applications of manure or other organic matter reduce surface crusting and increase crop yields.

The soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, and Nuttall saltbush decrease; and prairie junegrass,

Sandberg bluegrass, and inland saltgrass increase. Weedy plants likely to invade are foxtail barley, curlycup gumweed, plains pricklypear, and broom snakeweed. The potential plant community produces 800 pounds of forage per acre in favorable years and 300 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

The soil can be used for windbreaks. It is moderately affected by sodium, which limits the choice of shrub and tree species. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability, low soil strength, and high shrink-swell potential limit this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability. Basements and foundations for houses require special design because of the high shrink-swell potential and low soil strength.

Capability subclass IVs, dryland; Dense Clay range site, 10- to 14-inch precipitation zone.

47—Glendive fine sandy loam. This is a deep, well drained, nearly level soil on plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown fine sandy loam 7 inches thick. The substratum is light brownish gray fine sandy loam stratified with thin lenses of loamy sand to loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a severe hazard. The soil is subject to rare flooding.

Small areas of Hanly loamy fine sand and Havre loam are included with this soil in mapping.

The Glendive soil is used for irrigated and dryland crops. The main irrigated crops are alfalfa for hay, wheat, barley, corn for silage, and sugar beets. The main dryland crops are wheat, barley, and oats.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps control wind erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, needleandthread, and western wheatgrass. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, Indian ricegrass and prairie sandreed decrease and needleandthread, woody increasers, blue grama, and fringed sagewort increase. Weedy plants likely to increase are annual grasses, leafy spurge, Russian knapweed, and burdock. The potential plant community produces 1,600 pounds of forage per acre in favorable years and 800 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

Along the Milk River and its tributaries are narrow, uneven-aged stands of plains cottonwood. The timber has little commercial value because of the small amount available.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IIIe, dryland, and IIe, irrigated; Sandy range site, 10- to 14-inch precipitation zone.

48—Hanly loamy fine sand. This is a deep, well drained, nearly level and undulating soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown loamy fine sand 3 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray loamy fine sand stratified with thin lenses of sand and fine sandy loam.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard. This soil is droughty. It is subject to occasional flooding in spring.

Included with this soil in mapping are small areas of Glendive fine sandy loam and Havre loam.

This soil is used mainly as rangeland. In some areas it is used for irrigated alfalfa for hay.

Wind erosion and droughtiness are the main limitations to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or natural vegetation also helps control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, and needleandthread. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, Indian ricegrass and prairie sandreed

decrease and needleandthread, Woods rose, woody increasers, and green sagewort increase. Weedy plants likely to invade are annual grasses, leafy spurge, Russian knapweed, and burdock. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

This soil supports narrow stands of plains cottonwood along the Milk River and its tributaries. Except for local use these trees have little commercial value.

The hazard of flooding limits this soil for most urban uses.

Capability subclass VIw, dryland, and IIIs, irrigated; Sandy range site, 10- to 14-inch precipitation zone.

49—Harlem loam. This is a deep, well drained or moderately well drained, nearly level soil on flood plains and stream terraces. It formed in alluvium. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown loam 10 inches thick. The substratum, to a depth of 60 inches or more, is grayish brown silty clay loam stratified with thin lenses of loam and silt loam.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is subject to rare flooding.

Small areas of Havre silty clay loam, Glendive fine sandy loam, and soils that are moderately affected by salts and sodium are included with this soil in mapping.

This soil is used for dryland and irrigated crops. The main dryland crops are wheat, oats, and barley. The main irrigated crops are alfalfa for hay, wheat, barley, and corn for silage.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

It is important to prevent this soil from becoming affected by sodium and other salts. Proper application of water, proper design of irrigation and drainage systems, and lining irrigation canals help prevent salt and sodium buildup.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, blue grama, and fringed sagewort increase. Weedy plants likely to invade are annual grasses, leafy spurge, and Russian knapweed. The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, russet buffaloberry, and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IIIs, dryland, and IIs, irrigated; Silty range site, 10- to 14-inch precipitation zone.

50—Harlem silty clay loam. This is a deep, well drained or moderately well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent and are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown silty clay loam 10 inches thick. The substratum, to a depth of 60 inches or more, is grayish brown silty clay loam stratified with thin lenses of clay loam or silty clay.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil under native vegetation is 36 inches. Runoff is slow. Wind and water erosion is a slight hazard. This soil is subject to rare flooding.

Small areas of Havre loam and Lardell silty clay loam are included with this soil in mapping. Also included are small areas of Harlem silty clay.

This soil is used mainly for irrigated and dryland crops. The main irrigated crops are wheat, barley, and alfalfa for hay. Minor irrigated crops are sugar beets and corn for silage. The main dryland crops are wheat and barley.

It is important to prevent this soil from becoming affected by sodium and other salts. Proper application of water, proper design of irrigation and drainage systems, and lining irrigation canals help prevent salinity.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, Canby bluegrass, Nuttall saltbush, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, green needlegrass, Canby bluegrass, and western wheatgrass decrease and Sandberg bluegrass, prairie junegrass, and fringed sagewort increase. Weedy plants likely to invade are foxtail barley, cheatgrass, and curlycup gumweed. The potential plant community produces 1,300 pounds of

forage per acre in favorable years and 700 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IIIs, dryland, and IIs, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

51—Harlem silty clay loam, saline. This is a deep, moderately well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is olive gray silty clay loam 10 inches thick. The substratum, to a depth of 60 inches, is grayish brown silty clay loam stratified with thin lenses of clay loam and silty clay.

Permeability is slow, and the available water capacity is moderate because of the effect of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind and water erosion is a slight hazard. This soil is moderately affected by salts and sodium. It is subject to rare flooding. The water table is at a depth of 42 to 60 inches in spring and summer.

Small areas of Havre loam and Lardell silty clay loam are included with this soil in mapping. The Lardell soil is strongly affected by sodium.

This soil is used for irrigated crops and as rangeland. The main irrigated crops are alfalfa for hay, wheat, sugar beets, corn for silage, and barley.

This soil can be improved for irrigated crops by leaching as much of the salts and sodium as possible from the upper part of the soil. However, the leaching process is difficult and takes several years because of the slow downward movement of water through the soil. Lowering the level of salts and sodium in the surface layer and applying only enough water to meet crop needs improve yields. Proper use of water also reduces the excessive and detrimental accumulation of salts in the upper part of the soil. Tillage when the soil is too dry or too wet contributes to the formation of large clods that are very difficult to break down.

This soil is suited to use as rangeland. The potential plant community consists mainly of green needlegrass, Nuttall saltbush, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, green needlegrass and western wheatgrass decrease; and Sandberg bluegrass, blue grama, threadleaf sedge, silver sagebrush, prairie junegrass, and fringed sagewort increase. Weedy plants likely to invade are annual grasses and curlycup gumweed. The potential plant community produces 1,300 pounds of forage per acre in favorable years and 700 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. The choice of shrubs and trees is restricted to those that are resistant to salts and sodium. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IVs, dryland, and IVs, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

52—Harlem silty clay. This is a deep, well drained or moderately well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is olive gray silty clay 10 inches thick. The substratum, to a depth of 60 inches or more, is olive gray silty clay stratified with thin lenses of clay loam to clay.

Permeabilty is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is about 30 inches. Runoff is slow. Wind and water erosion are slight hazards. This soil is subject to rare flooding.

Included with this soil in mapping are small areas of Lardell silty clay loam, Havre silty clay loam, and Bowdoin clay. The Lardell soil is strongly affected by salts, and the Bowdoin soil is strongly affected by sodium.

This soil is used for irrigated and dryland crops. The main irrigated crops are wheat, barley, alfalfa for hay, corn for silage, and sugar beets. The main dryland crops are wheat and barley.

It is important to prevent this soil from becoming affected by sodium and other salts. Proper application of water, proper design of irrigation and drainage systems, and lining irrigation canals help prevent salinity.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of green needlegrass, western wheatgrass, Nuttall saltbush, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, green needlegrass and western wheatgrass decrease; and Sandberg bluegrass, plains

reedgrass, blue grama, prairie junegrass, and fringed sagewort increase. Weedy plants likely to invade are leafy spurge, annual clubmoss, and Russian knapweed. The potential plant community produces 1,300 pounds of forage per acre in favorable years and 700 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, Rocky Mountain juniper, and Scotch pine. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, silver buffaloberry, and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IIIs, dryland, and IIIs, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

53—Harlem silty clay, saline. This is a deep, moderately well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is olive gray silty clay 6 inches thick. The substratum, to a depth of 60 inches or more, is olive gray silty clay stratified with thin lenses of clay loam to clay.

Permeability is slow, and the available water capacity is moderate because of the effect of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil under native vegetation is 30 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is moderately affected by salts and sodium. This soil is subject to rare flooding. The water table is at a depth of 42 to 60 inches in spring and summer.

Included with this soil in mapping are small areas of Harlem silty clay loam, Lardell silty clay loam, Marvan clay, and Vanda clay. The Lardell soil is strongly affected by salts.

This soil is used mainly for irrigated crops. The main crops are wheat, barley, alfalfa for hay, sugar beets, and corn for silage. In a few small areas this soil is used as rangeland.

The quality of this soil for irrigated crops can be improved by leaching as much of the salts and sodium as possible from the upper part of the soil. However, the leaching process is difficult and takes several years because of the slow downward movement of water through the soil. Lowering the salts and sodium level in the surface layer can improve crop yields.

Application of only enough water to meet crop needs can also improve yields. Proper use of water reduces the excessive and detrimental accumulation of salts and sodium in the upper part of the soil. Tillage when the soil is too dry or too wet contributes to the formation of large clods that are very difficult to break down.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, and contour stripcropping can effectively control wind erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of green needlegrass, Nuttall saltbush, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, green needlegrass and western wheatgrass decrease and Sandberg bluegrass, blue grama, threadleaf sedge, silver sagebrush, prairie junegrass, and fringed sagewort increase. Weedy plants likely to invade are annual grasses and curlycup gumweed. The potential plant community produces 1,300 pounds of forage per acre in favorable years and 700 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. The choice of shrubs and trees is restricted to those that are resistant to salts and sodium. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, silver buffaloberry, and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IVs, dryland, and IVs, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

54—Harlem Variant-Lardell silty clay loams. This complex consists of nearly level soils on flood plains and stream terraces in valleys. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Harlem Variant makes up about 60 percent of the map unit, and the Lardell soil makes up 30 percent. Included in mapping are small areas of Havre silty clay loam and Harlem silty clay loam. These soils are moderately affected by salts and sodium.

The Harlem Variant is deep and somewhat poorly drained. It is strongly affected by salts and sodium. It formed in alluvium on flood plains and stream terraces. Typically, the surface layer is grayish brown silty clay loam 7 inches thick. Below that, to a depth of 60 inches, the substratum is grayish brown silty clay loam stratified with thin lenses of loam to silty clay. When this soil is dry, few to many fine salt crystals are visible in the surface layer.

Permeability is slow, and the available water capacity is moderate because of the effect of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth where the soil is in native

vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. Flooding is rare. The water table is 2 to 4 feet below the surface in summer.

This soil is wet and is strongly affected by salts and sodium because of the long term use of too much water for irrigation and the excessive losses of water from ditches. The upward movement of water through capillary rise from the seasonal high water table and the subsequent evaporation have brought concentrations of salts to or near the surface. This soil can be improved by leaching as much of the salts and sodium as possible from the upper part of the soil. However, the leaching process is difficult and takes many years because of the slow downward movement of water through the soil.

The Lardell soil is deep and somewhat poorly drained. It is very strongly affected by salts and sodium. It formed in alluvium on flood plains and stream terraces. Typically, the surface layer of this soil is grayish brown silty clay loam 8 inches thick. The substratum, to a depth of 29 inches, is grayish brown silty clay loam; and, to a depth of 60 inches or more, it is light brownish gray loam stratified with thin lenses of fine sandy loam to silty clay loam. When this soil is dry, salt crystals are visible throughout the profile.

Permeability is slow, and the available water capacity is low because of the effects of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. Flooding is rare. The water table is at a depth of 1 to 5 feet in summer.

Reclaiming this soil is slow, difficult, and expensive because of the slow permeability, drainage problems, and the large amount of sodium salts and other salts that are characteristic of this soil.

The soils in this complex are not suited to cultivated crops because of the salts.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Harlem Variant soil. The potential plant community consists mainly of western wheatgrass, alkali sacaton, alkali cordgrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. If the rangeland is overgrazed, desirable plants such as western wheatgrass, alkali sacaton, alkali cordgrass, and Nuttall saltbush decrease, and plants such as Sandberg bluegrass, prairie junegrass, fringed sagewort, and mat muhly increase. Weedy plants likely to invade are foxtail barley, curlycup gumweed, kochia, leafy spurge, cheatgrass, and Russian thistle. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,200 pounds per acre in unfavorable years.

The soils in this complex are not suited to windbreaks because of the effect of the salts.

Although the soils are rarely flooded, flooding is a limitation for most urban uses.

Capability subclass VIw, irrigated; Saline Lowland range site, 10- to 14-inch precipitation zone.

55—Havre loam. This is a deep, well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown loam 8 inches thick. The substratum, to a depth of 60 inches, is light brownish gray loam stratified with thin lenses of fine sandy loam to clay loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is subject to rare flooding.

Included with this soil in mapping are small areas of Glendive fine sandy loam and Harlem silty clay loam.

This soil is used mainly for dryland and irrigated crops and as rangeland. The main dryland crops are wheat, barley, and oats. The main irrigated crops are wheat, barley, sugar beets, corn silage, and alfalfa for hay.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, blue grama, and fringed sagewort increase. Weedy plants likely to invade are annual grasses, Russian knapweed, and leafy spurge. The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IIIe, dryland, and IIc, irrigated; Silty range site, 10- to 14-inch precipitation zone.

56—Havre loam, saline. This is a deep, well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are 0 to 2 percent and are mainly

long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown loam 8 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray loam stratified with thin lenses of fine sandy loam to clay loam. When the soil is dry, few to many fine salt crystals are visible in the surface layer.

Permeability is moderate, and the available water capacity is moderate because of the effect of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The soil is moderately affected by salts and sodium. This soil is subject to rare flooding. The water table is at a depth of 42 to 60 inches in summer.

Included with this soil in mapping are a few small areas of Lardell silty clay loam that is strongly affected by salts and sodium. Also included are soils that have a fine sandy loam or silty clay loam surface layer and are not affected by salts or sodium.

The Havre soil is used mainly for irrigated cropland, but in small areas it is used as rangeland. The main irrigated crops are wheat, barley, sugar beets, corn for silage, and alfalfa.

The long term use of excess water for irrigation has made this soil moderately affected by salts and sodium. However, the quality of this soil for irrigated crops can be improved by leaching as much of the salts and sodium as possible from the upper part of the soil. Lowering the level of sodium salts and other salts in the surface layer improves crop yields.

Application of only enough water to meet crop needs can also improve yields. Proper use of water reduces the excessive and detrimental accumulation of salts and sodium in the upper part of the soil.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage which utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of basin wildrye, alkali sacaton, alkali cordgrass, Nuttall alkaligrass, Nuttall saltbush, and silver sagebrush. If the rangeland is overgrazed, basin wildrye, alkali sacaton, alkali cordgrass, and Nuttall saltbush decrease; and western wheatgrass, inland saltgrass, and fringed sagewort increase. Weedy plants likely to invade are foxtail barley, cheatgrass, kochia, Russian knapweed, and leafy spurge. The potential plant community produces 1,800 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks, but droughtiness caused by salts and sodium restricts the choice of shrubs and trees. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, lilac, American plum, and silver buffaloberry.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IVs, dryland, and IVs, irrigated; Silty range site, 10- to 14-inch precipitation zone.

57—Havre silty clay loam. This is a deep, well drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown silty clay loam 8 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray loam stratified with thin lenses of fine sandy loam to clay loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is subject to rare flooding.

Included with this soil in mapping are small areas of Harlem silty clay and soils that are moderately and strongly affected by salts.

This soil is used for dryland and irrigated crops. In small areas it is used as rangeland. The main dryland crops are wheat, barley, and oats. The main irrigated crops are alfalfa for hay, wheat, barley, sugar beets, and corn for silage.

Because this soil tends to become affected by salts, it is limited for irrigated crops. Proper application of water, proper design of irrigation and drainage systems, and lining irrigation canals help prevent salt buildup.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage which utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, Canby bluegrass, Nuttall saltbush, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, Canby bluegrass, green needlegrass, and western wheatgrass decrease and Sandberg bluegrass, prairie junegrass, and fringed sagewort increase. Weedy plants likely to invade are annual grasses and curlycup gumweed. The potential plant community produces 1,300 pounds of forage per acre in favorable years and 700 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white

willow, golden willow, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IIIe, dryland, and IIc, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

58—Havre silty clay loam, saline. This is a deep, well drained, nearly level soil on flood plains and stream terraces. It formed in alluvium. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent and are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown silty clay loam 10 inches thick. The substratum, to a depth of 60 inches, is light brownish gray loam stratified with thin lenses of fine sandy loam to clay loam. When the soil is dry, few to many fine salt crystals are visible in the surface layer.

Permeability is moderately slow, and the available water capacity is moderate because of the effect of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is moderately affected by salts and sodium. It is subject to rare flooding. The water table is at a depth of 42 to 60 inches in summer.

Included with this soil in mapping are small areas of Harlem silty clay and Lardell silty clay loam. The Lardell soil is very strongly affected by salts and sodium.

This soil is used for irrigated crops. In a few small areas it is used as rangeland. The main irrigated crops are alfalfa for hay, wheat, barley, sugar beets, and corn for silage.

This soil can be improved for irrigated crops by leaching as much of the salts and sodium as possible from the upper part of the soil. However, the leaching process is difficult and takes several years because of the slow downward movement of water through the soil. Lowering the level of salts and sodium in the surface layer and applying only enough water to meet crop needs improve yields.

Wind erosion is also a limitation to use of this soil for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of basin wildrye, alkali sacaton, alkali cordgrass, Nuttall saltbush, Nuttall alkaligrass, and silver sagebrush. If the rangeland is overgrazed, basin wildrye, alkali sacaton, alkali cordgrass, and Nuttall saltbush decrease; and western wheatgrass, inland saltgrass, and fringed sagewort increase. Weedy plants likely to invade are foxtail, barley, cheatgrass, kochia, leafy spurge, Russian knapweed, annual grasses, and curlycup gumweed. The potential plant community produces 1,800 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Because this soil is moderately affected by salts and sodium, the choice of shrubs and trees is restricted. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. When irrigated, this soil is also suitable for Scotch pine and lilac.

Although the soil is rarely flooded, the hazard of flooding limits this soil for most urban uses.

Capability subclass IVs, dryland, and IVs, irrigated; Silty range site, 10- to 14-inch precipitation zone.

59—Havre, Hanly, and Glendive soils, channeled. This map unit consists of deep, well drained and moderately well drained Havre, Hanly, and Glendive soils on bottom lands and stream terraces. These soils formed in alluvium. The elevation is 2,300 to 3,500 feet. Slopes are 0 to 2 percent. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

These soils are in areas dissected by stream channels, in narrow channeled valleys and drainageways, and on multilevel terraces, low steep knolls, and sides of valleys. They are subject to occasional flooding.

Typically, the surface layer of the Havre soil is grayish brown loam 8 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray loam stratified with thin lenses of fine sandy loam to clay loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard except where channeling or streambank erosion occurs.

Typically, the surface layer of the Hanly soil is grayish brown loamy fine sand 3 inches thick. The substratum, to a depth of 60 inches, is light brownish gray loamy fine sand stratified with thin lenses of sand and fine sandy loam.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth under native vegetation is 36 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard, except where channeling or streambank erosion occurs.

Typically, the surface layer of the Glendive soil is grayish brown fine sandy loam 7 inches thick. The

substratum, to a depth of 60 inches or more, is light brownish gray fine sandy loam stratified with thin lenses of loamy sand to loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth under native vegetation is 36 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard except where channeling or streambank erosion occurs.

Included in mapping are small areas of Harlem soils, very gravelly soils, and soils that are wet or wet and saline.

The soils in this map unit are not suited to cultivated crops because the landscape is dissected by stream channels and drainageways.

These soils are suited to use as rangeland and are used as rangeland. The potential plant community consists mainly of basin wildrye, prairie cordgrass, tall sedges, and tufted hairgrass. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, basin wildrye, prairie cordgrass, and tufted hairgrass decrease and western wheatgrass, Baltic rush, and shrubby cinquefoil increase. Weedy plants likely to invade are foxtail barley and Kentucky bluegrass. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

Channels severely limit the use of machinery on these soils in preparing a seedbed and in planting.

The hazard of occasional flooding limits these soils for most urban uses.

Capability subclass VIIw, dryland; Overflow range site, 15- to 19-inch precipitation zone.

60—Havre Variant-Lardell silty clay loams. This complex consists of nearly level soils on flood plains and stream terraces. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Havre Variant makes up about 60 percent of the map unit, and the Lardell soil makes up about 30 percent. Included in mapping, and making up about 10 percent of the unit, are small areas of Harlem silty clay loam and Glendive fine sandy loam. Also included are areas of soils that are slightly affected by salts.

Havre Variant is deep and strongly affected by salts and sodium. It formed in alluvium on flood plains and stream terraces. Typically, the surface layer is grayish brown silty clay loam 7 inches thick. The substratum, to a depth of 60 inches, is grayish brown or light brownish gray loam stratified with thin lenses of fine sandy loam to silty clay loam.

Permeability is moderately slow, and the available water capacity is moderate because of the effect of sodium and other salts. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is subject to rare flooding. The water table is at a depth of 24 to 48 inches in summer.

This soil is wet and strongly affected by salts and sodium because of the long term use of excess water for irrigation and the excessive losses of water from ditches. The upward movement of water through capillary rise from the seasonally high water table and the subsequent evaporation from the surface have brought concentrations of salts to the surface layer. This soil can be improved by leaching as much of the salts and sodium as possible from the upper part of the soil. However, the leaching process is difficult and takes many years because of the slow downward movement of water through the soil.

The Lardell soil is deep and somewhat poorly drained. It is very strongly affected by salts and sodium. It formed in alluvium on flood plains and stream terraces. Typically, the surface layer is grayish brown silty clay loam 8 inches thick. The substratum, to a depth of 29 inches, is grayish brown silty clay loam, and, to a depth of 60 inches or more, it is light brownish gray loam stratified with thin lenses of fine sandy loam to silty clay loam. When the soil is dry, many fine salt crystals are visible throughout the profile.

Permeability is slow. The available water capacity is low because of the effect of salts and sodium. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. This soil is subject to rare flooding. The water table is at a depth of 12 to 60 inches in summer.

Reclaiming this soil is slow, difficult, and expensive because of the slow permeability, the drainage problem, and the high amount of sodium and other salts that are characteristic of the soil.

The soils in this complex are not suited to cultivated crops because of the salts.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Havre Variant. The potential plant community on Havre Variant consists mainly of western wheatgrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. The potential plant community on the Lardell soil consists mainly of alkali sacaton, Nuttall alkaligrass, Nuttall saltbush, and greasewood. If the rangeland is overgrazed, alkali sacaton and Nuttall saltbush decrease and inland saltgrass, needleandthread, blue grama, fringed sagewort, and mat muhly increase. Weedy plants likely to invade are annual grasses, kochia, Russian thistle, and leafy spurge. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,200 pounds in unfavorable years.

Havre Variant is suitable for seeding of desirable native species and adapted introduced species. Forage

production is increased by complete seedbed preparation and seeding of native species, such as thickspike wheatgrass, slender wheatgrass, and western wheatgrass. The Lardell soil is not suitable for seeding.

The soils in this complex are not suitable for windbreaks because of the salts and sodium.

Although the soils are rarely flooded, the hazard of flooding is a limitation for most urban uses.

Capability subclass VIw, irrigated; Saline Lowland range site, 10- to 14-inch precipitation zone.

61—Hedoes loam, 2 to 4 percent slopes. This is a deep, well drained soil on fans and foot slopes on uplands and mountains. It formed in colluvium and alluvium. The elevation is 3,000 to 6,000 feet. Slopes are mainly medium in length. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

Typically, the surface layer of this soil is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam 13 inches thick. The upper part of the substratum is grayish brown sandy loam 17 inches thick, and the lower part is grayish brown very gravelly coarse sandy loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Belain and Benz soils are included with this soil in mapping. The Belain soil is gently sloping and moderately deep. It is on knolls. The Benz soil is gently sloping and is strongly affected by sodium. It is in very small depressions.

The Hedoes soil is used mainly as rangeland. In small areas it is used for irrigated and dryland crops. The main dryland crops are wheat, barley, and oats. The main irrigated crops are alfalfa for hay and barley.

Wind erosion is the main limitation to use of this soil for cultivated crops; however, stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and big sagebrush increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. The moderate available water capacity restricts the choice of shrubs and trees to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, lilac, silver buffaloberry, and Nanking cherry.

This soil is suited to most urban uses. Because permeability in the substraum is moderately rapid, underground water supplies can be polluted by liquid and solid wastes from sanitary disposal systems.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

62—Hedoes loam, 4 to 8 percent slopes. This is a deep, well drained soil on fans and foot slopes on uplands and mountains. It formed in colluvium and alluvium. The elevation is 3,000 to 6,000 feet. Slopes are mainly medium in length. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

Typically, the surface layer of this soil is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam 13 inches thick. The upper part of the substratum is grayish brown sandy loam 17 inches thick. The lower part is grayish brown very gravelly sandy loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

Small areas of Benz, Belain, and Castner soils are included with this soil in mapping. The Benz soil is gently sloping and strongly affected by sodium. It is in small depressions on the lower part of slopes. The Belain soil is moderately sloping and moderately deep. It is on the upper part of slopes on knolls and ridges. The Castner soil is strongly sloping and shallow. It is on top of knolls and ridges.

The Hedoes soil is used mainly as rangeland. In a few small areas it is used for dryland and irrigated crops. The main dryland crops are wheat, barley, and oats. The main irrigated crops are alfalfa for hay and barley.

Wind and water erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue,

bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and big sagebrush increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. The moderate available water capacity restricts the choice of shrubs and trees. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, lilac, silver buffaloberry, and Nanking cherry.

This soil is suited to urban uses. Because permeability in the substratum is moderately rapid, underground water supplies can be polluted by liquid and solid wastes from sanitary disposal systems.

Capability subclass IIIe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

63—Hedoes-Belain loams, 4 to 15 percent slopes. This complex consists of moderately sloping to strongly rolling soils on fans, foot slopes, hillsides, and ridges. The elevation is 3,000 to 6,000 feet. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

The Hedoes soil makes up about 60 percent of the map unit, and the Belain soil makes up about 30 percent. Included with these soils in mapping are small areas of Benz, Castner, and Farnuf soils. These soils make up about 10 percent of the unit. The Benz soil is strongly affected by sodium in small, sparsely vegetated depressions. The Castner soil is strongly sloping and shallow. It is on top of ridges and knolls.

The Hedoes soil is deep and well drained. It formed in colluvium and alluvium on fans and foot slopes. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam 13 inches thick. The upper part of the substratum is grayish brown sandy loam 17 inches thick, and the lower part is grayish brown, very gravelly sandy loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

The Belain soil is moderately deep and well drained. It formed on hills, ridges, and the upper part of slopes in material that weathered from hard igneous rock. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam and gravelly loam 11 inches thick. The substratum is brown gravelly loam and very gravelly loam 13 inches thick. Igneous bedrock is at a depth of 28 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is medium. Wind and water erosion are moderate hazards. The depth to hard igneous bedrock is 20 to 40 inches.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland and irrigated crops. The main dryland crops are barley, oats, and wheat. The main irrigated crop is alfalfa for hay.

Droughtiness and wind and water erosion are the main limitations to use of these soils for cultivated crops. Because of droughtiness, successful crop production depends on suitable distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall grass barriers for trapping windblown snow help to conserve moisture. Stripcropping, tall grass barriers, minimum tillage, and stubble mulch tillage can effectively control wind and water erosion.

The soils in this complex are suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils in this complex can be used for windbreaks. The droughtiness of these soils restricts the choice of trees and shrubs. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

Mixed stands of aspen, Douglas-fir, and ponderosa pine grow on these soils in the moister areas. The stands of ponderosa pine and Douglas-fir are productive enough to have commercial value. Ponderosa pine has a site index of about 60 to 70 and Douglas-fir, 40 to 45.

Hard igneous bedrock at a depth of 20 to 40 inches in the Belain soil limits these soils for most urban uses. The depth to hard bedrock seriously limits the construction of houses with basements and the design

of sanitary waste disposal systems. Underground water supplies can be polluted by waste from sanitary disposal systems.

Capability subclass IVe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

64—Hedoes-Belain loams, 15 to 35 percent slopes. This complex consists of hilly to steep soils on fans and foot slopes and on sides of hills and mountains. The elevation is 3,000 to 6,000 feet. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

The Hedoes soil makes up about 45 percent of this map unit, and the Belain soil makes up about 40 percent. Included with these soils in mapping, and making up 15 percent of the unit, are small areas of Farnuf and Castner soils and of Rock outcrop.

The Hedoes soil is deep and well drained. It formed in colluvium and alluvium on fans and foot slopes. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam 13 inches thick. The upper part of the substratum is grayish brown sandy loam 17 inches thick, and the lower part is grayish brown very gravelly sandy loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is medium. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Belain soil is moderately deep and well drained. It formed on the upper part of slopes on hills, ridges, and mountains in material weathered from hard igneous rock. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam and gravelly loam 11 inches thick. The substratum is brown gravelly loam and very gravelly loam 13 inches thick. Igneous bedrock is at a depth of 28 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth to hard igneous bedrock is 20 to 40 inches.

The soils in this complex are not suitable for cultivated crops because of slope and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Hedoes soil. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue and bluebunch wheatgrass decrease and Idaho fescue, needleandthread, blue grama, prairie junegrass, and threadleaf sedge increase. Weedy plants likely to invade are annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

Mixed stands of aspen, Douglas-fir, and ponderosa pine grow on these soils in the moister areas. The stands of ponderosa pine and Douglas-fir are productive enough to have commercial value. Ponderosa pine has a site index of about 60 to 70 and Douglas-fir, 40 to 45.

The soils in this complex are not suited to windbreaks because slopes are more than 15 percent.

Slope limits these soils for most urban uses. Hard bedrock at a depth of 20 to 40 inches in the Belain soil is also a limitation for most urban uses.

Capability subclass VIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

65—Hedoes-Belain-Castner complex, 15 to 60 percent slopes. This complex consists of moderately steep to steep Hedoes soil, steep Belain soil, and very steep Castner soil on hills, ridges, and mountains (fig. 1). The elevation is 3,000 to 6,000 feet. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

The Hedoes soil makes up about 40 percent of this map unit, the Belain soil makes up about 25 percent, and the Castner soil about 20 percent. Included with these soils in mapping, and making up about 15 percent of the unit, are small areas of Perma soil and Rock outcrop. The steep to very steep Perma soil is on the side slopes of hills, ridges, and mountains. This soil contains a high amount of rock fragments, and it is droughty. The Rock outcrop is on ridgetops.

The Hedoes soil is deep and well drained. It formed in alluvium and colluvium on fans and foot slopes. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam 13 inches thick. The substratum is grayish brown sandy loam 17 inches thick, and the lower part is grayish brown, very gravelly sandy loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

The Belain soil is moderately deep and well drained. It formed on the upper part of slopes on ridges, hills, and mountains in material that weathered from hard igneous rock. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam and gravelly loam 11 inches thick. The substratum is brown

Figure 1.—The Hedoes-Belain-Castner complex is on the barren hilly area in the background. The Macmeal association is in the wooded area on the left. The Hedoes-Belain loams are on the slopes in the center foreground.

gravelly loam and very gravelly loam 13 inches thick. Igneous bedrock is at a depth of 28 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Hard igneous bedrock is at a depth of 20 to 40 inches.

The Castner soil is shallow and well drained. It formed on hills, ridges, and mountains in material that weathered from hard igneous rock and hard sandstone. Typically, the surface layer is dark grayish brown gravelly loam 6 inches thick. The substratum is brown very channery loam 7 inches thick. Hard bedrock is at a depth of 13 inches.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 13 inches. The average annual wetting depth of the soil under native vegetation is 13 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. The depth to hard rock is 10 to 20 inches.

The soils in this complex are not suited to cultivated crops because of slope and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced by the Hedoes and Belain soils. The potential plant community on these soils consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. The potential plant community on the Castner soil consists mainly of bluebunch wheatgrass, rough fescue, green needlegrass, Idaho fescue, needleandthread, and conifers. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue and

bluebunch wheatgrass decrease and Idaho fescue, needleandthread, blue grama, fringed sagewort, prairie junegrass, and threadleaf sedge increase. Weedy plants likely to invade are annual grasses, broom snakeweed, and pussytoes.

On the Hedoes soil, the potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years. On the Belain soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds in unfavorable years. On the Castner soil, forage production is 1,200 pounds per acre in favorable years and 700 pounds in unfavorable years.

The soils in this complex are poorly suited to timber production. However, a few ponderosa pine and Douglas-fir trees of merchantable quality are on the north aspects.

These soils are not suited for windbreaks because the slopes are more than 15 percent.

The moderately steep to very steep slopes and the depth to bedrock in the Belain and Castner soils limit these soils for most urban uses.

Capability subclass VIIe, dryland. The Hedoes soil is in Silty range site, 15- to 19-inch precipitation zone; the Belain soil is in Thin Hilly range site, 15- to 19-inch precipitation zone; and the Castner soil is in Shallow range site, 15- to 19-inch precipitation zone.

66—Hedoes-Benz loams, 2 to 4 percent slopes. This complex consists of gently sloping soils on fans, terraces, and foot slopes. The elevation is 3,000 to 6,000 feet. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

The Hedoes soil makes up about 70 percent of the map unit, and the Benz soil makes up about 20 percent. Included with these soils in mapping, and making up about 10 percent of the unit, are small areas of Belain and Farnuf soils. The Belain soil is gently sloping and moderately sloping and moderately deep. It is on low knolls and ridges.

The Hedoes soil is deep and well drained. It formed in colluvium and alluvium on fans, terraces, and foot slopes. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam 13 inches thick. The upper part of the substratum is grayish brown sandy loam 17 inches thick, and the lower part is grayish brown very sandy loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 17 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Benz soil is deep and well drained. It formed in alluvium in barren or nearly barren small depressions. Typically, the surface layer is grayish brown loam 3 inches thick. The substratum is mainly grayish brown loam and clay loam stratified with thin lenses of fine sandy loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 25 inches. Runoff is medium. Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is strongly affected by sodium. When dry, it is very hard, and a crust forms on the surface.

These soils are used mainly as rangeland. In some areas they are used for dryland crops. The main crops are wheat, barley, and oats.

Wind erosion is the main limitation to use of these soils for cultivated crops, but stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

These soils are suited to use as rangeland. Most of the forage is produced on the Hedoes soil. The potential plant community on the Hedoes soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. The potential plant community on the Benz soil consists of needleandthread, western wheatgrass, prairie junegrass, Sandberg bluegrass, inland saltgrass, Nuttall saltbush, and greasewood. Forbs are decreasers. If the rangeland is overgrazed, rough fescue, green needlegrass, bluebunch wheatgrass, western wheatgrass, and Nuttall saltbush decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are Kentucky bluegrass, foxtail barley, Hood phlox, and pussytoes.

On the Hedoes soil, the potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years. On the Benz soil, forage production is 400 pounds per acre in favorable years and 200 pounds in unfavorable years.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

The Hedoes soil can be used for windbreaks. The moderate available water capacity restricts the choice of trees and shrubs. Suitable trees are Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry. The Benz soil is not suited to windbreaks because it is strongly affected by sodium.

The slow permeability of the Benz soil limits these soils for most urban uses. Septic tank absorption fields on the Benz soil require special design because of the slow permeability. Because permeability in the substratum of the Hedoes soil is moderately rapid, waste

from sanitary disposal systems can pollute underground water supplies.

Capability subclass IVs, dryland. Hedoes soil is in Silty range site, 15- to 19-inch precipitation zone; Benz soil is in Saline Upland range site, 15- to 19-inch precipitation zone.

67—Hillon clay loam, 25 to 45 percent slopes. This is a deep, well drained, steep soil on glaciated uplands. It formed in glacial till. The elevation is 2,300 to 3,600 feet. Slopes are mainly short. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is brown clay loam 4 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 26 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

Small areas of Kevin, Lisam, and Cabbart soils are included with this soil in mapping. The Lisam and Cabbart soils are on the steeper part of slopes. The Kevin soil is on foot slopes.

This soil is not suited to cultivated crops because of the steep slope and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of western wheatgrass, bluebunch wheatgrass, needleandthread, green needlegrass, prairie sandreed, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, bluebunch wheatgrass, and green needlegrass decrease and needleandthread, blue grama, and threadleaf sedge increase. Weedy plants likely to invade are annual grasses, needleleaf sedge, and broom snakeweed. The potential plant community produces 900 pounds of forage per acre in favorable years and 300 pounds in unfavorable years.

This soil is not suited to windbreaks because of the steep slope.

Slope is the main limitation to use of this soil for most urban uses.

Capability subclass VIIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

68—Hillon-Kevin clay loams, 15 to 35 percent slopes. This complex consists of soils on glaciated uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Hillon soil makes up about 45 percent of this map unit, and the Kevin soil makes up about 40 percent. Included with these soils in mapping are small areas of Chinook, Scobey, and Yamac soils. These soils make up about 15 percent of the unit.

The Hillon soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer is brown clay loam 4 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is about 26 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

The Kevin soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer, if mixed to a depth of 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

These soils are not suited to cultivated crops because of slope and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

The soils in this complex are suited to use as rangeland and are used as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, little bluestem, and prairie sandreed. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, prairie junegrass, blue grama, and threadleaf sedge increase. Weedy plants likely to invade are annual grasses, needleleaf sedge, broom snakeweed, and clubmoss. The potential plant community produces 900 pounds of forage per acre in favorable years and 300 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

The soils in this complex are not suited to windbreaks because of slope. Slope also limits these soils for most urban uses.

Capability subclass VIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

69—Hillon-Scobey clay loams, 4 to 20 percent slopes. This complex consists of strongly rolling to hilly

Hillon soil and gently rolling Scobey soil on glaciated uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Hillon soil makes up about 40 percent of this map unit, and the Scobey soil makes up about 40 percent. Included with these soils in mapping are small areas of Dimmick, Nishon, and Kevin soils. These soils make up about 20 percent of the unit. The level or nearly level Dimmick and Nishon soils are in small enclosed basins.

The Hillon soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer is brown clay loam 4 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 26 inches. Runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The soil is calcareous, and yields from cultivated crops are low.

The Scobey soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is grayish brown clay loam 6 inches thick. The upper part of the subsoil is brown clay 6 inches thick, and the lower part is grayish brown clay loam 7 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

The soils in this complex are used mainly as rangeland. In small areas they are used for dryland crops. The main crops are wheat, barley, and oats.

Wind and water erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion. A permanently and adequately maintained cover of planted grasses or of natural vegetation also helps control wind and water erosion.

These soils are suited to use as rangeland. Most of the forage is produced on the Scobey soil. The potential plant community on the Scobey soil consists of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. The potential plant community on the Hillon soil consists mainly of western wheatgrass, green needlegrass, bluebunch wheatgrass, winterfat, and prairie sandreed. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, and bluebunch wheatgrass decrease and needleandthread, blue grama, prairie junegrass, fringed sagewort, and threadleaf sedge increase. Weedy plants likely to invade are annual grasses, clubmoss, and broom snakeweed.

On the Hillon soil, the potential plant community produces 900 pounds of forage per acre in favorable years and 300 pounds in unfavorable years. On the Scobey soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability and slope of the Hillon soil and the slow permeability of the Scobey soil limit these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability of both soils and the slope of the Hillon soil.

Capability subclass IVe, dryland. Hillon soil is in Thin Hilly range site, 10- to 14-inch precipitation zone; Scobey soil is in Silty range site, 10- to 14-inch precipitation zone.

70—Judith-Windham complex, 4 to 8 percent slopes. This complex consists of gently rolling soils on terraces and fans on uplands. The elevation is 3,200 to 4,500 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Judith soil makes up about 55 percent of this map unit, and the Windham soil makes up about 35 percent. Included with these soils in mapping, and making up about 10 percent of the unit, are small areas of Martinsdale soil.

The Judith soil is deep and well drained. It formed in alluvium on the lower part of slopes. Typically, the surface layer is dark grayish brown loam 5 inches thick. The upper part of the substratum is pale brown and very pale brown loam 33 inches thick, and the lower part is pale brown very gravelly loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 33 inches and moderately rapid below that. The available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion is a moderate hazard. The Judith soil has a high content of lime at a shallow depth and is droughty.

The Windham soil is deep and well drained. It formed in alluvium on terraces and fans. Typically, the surface

layer is dark grayish brown gravelly loam 6 inches thick. The substratum, to a depth of 60 inches or more, is pale brown very gravelly loam.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion is a moderate hazard. This soil has many coarse fragments throughout the profile, and it is very droughty.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops. The main crops are wheat and barley.

Wind erosion, water erosion, and droughtiness are the main limitations to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion. Tall grass barriers, minimum tillage, and tillage that utilizes crop residue also help conserve moisture.

These soils are suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, basin wildrye, and a few ponderosa pine. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, blue grama, western wheatgrass, prairie junegrass, fringed sagewort, common snowberry, and big sagebrush increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils in this complex can be used for windbreaks. The content of lime at a shallow depth and droughtiness limit the choice of trees and shrubs. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The moderately rapid permeability in the substratum of the Judith soil limits these soils for most urban uses. Because permeability in the substratum is moderately rapid, ground water can be polluted by liquid and solid waste from disposal systems.

Capability subclass IVs, dryland; Silty range site, 15- to 19-inch precipitation zone.

71—Judith-Windham complex, 8 to 15 percent slopes. This complex consists of strongly rolling soils on terraces and fans on uplands. The elevation is 3,200 to 4,500 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Judith soil makes up about 45 percent of this map unit, and the Windham soil makes up about 45 percent. Included with these soils in mapping, and making up about 10 percent of the unit, are small areas of Martinsdale soil.

The Judith soil is deep and well drained. It formed in alluvium on the lower part of slopes. Typically, the surface layer is dark grayish brown loam 5 inches thick. The substratum is pale brown and very pale brown loam to a depth of 33 inches and very pale brown very gravelly loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 33 inches and moderately rapid below that. The available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion is a moderate hazard. The Judith soil has a high content of lime at a shallow depth, and it is droughty.

The Windham soil is deep and well drained. It formed in alluvium on terraces and fans. Typically, the surface layer is dark grayish brown gravelly loam 6 inches thick. The substratum, to a depth of 60 inches, is pale brown very gravelly loam.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion is a moderate hazard. This soil has many coarse fragments throughout the profile, and it is very droughty.

The soils in this complex are poorly suited to cultivated crops because of slope and droughtiness.

These soils are suited to use as rangeland and are used as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, basin wildrye, and ponderosa pine. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, blue grama, needleandthread, western wheatgrass, prairie junegrass, fringed sagewort, common snowberry, and big sagebrush increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. The high content of lime at a shallow depth and droughtiness limit the choice of trees and shrubs. Suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The moderately rapid permeability in the substratum of the Judith soil limits these soils for most urban uses.

Because permeability in the substratum is moderately rapid, ground water can be polluted by liquid and solid waste from disposal systems.

Capability subclass IVe, dryland; Silty range site, 15- to 19-inch precipitation zone.

72—Kevin clay loam, 2 to 8 percent slopes. This is a deep, well drained, undulating to gently rolling soil on uplands. It formed in glacial till. The elevation is 2,300 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer, where mixed, is grayish brown clay loam to a depth of 7 inches. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is about 36 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

Small areas of Elloam, Hillon, Phillips, and Scobey soils are included with this soil in mapping. The Hillon soil is strongly rolling and is on knolls and ridges.

The Kevin soil is used as rangeland and for dryland crops. The main dryland crops are wheat, barley, and oats. The soil is also used for irrigated alfalfa for hay.

Wind and water erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps control erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, prairie junegrass, blue grama, and fringed sagewort increase. Weedy plants likely to invade are annual grasses, clubmoss, and broom snakeweed. The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirabie native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland, and IIIe, irrigated; Silty range site, 10- to 14-inch precipitation zone.

73—Kevin-Elloam clay loams, 2 to 8 percent slopes. This complex consists of undulating to gently rolling soils on glaciated plains. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Kevin soil makes up about 60 percent of this map unit, and the Elloam soil makes up about 20 percent. Included with these soils in mapping, and making up about 20 percent of the unit, are small areas of Hillon, Phillips, Scobey, and Thoeny soils. The Thoeny soil is in vegetated depressions.

The Kevin soil is deep and well drained. It formed in glacial till in smooth areas on uplands. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

The Elloam soil is deep and well drained. It formed in glacial till in sparsely vegetated, small depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is light brownish gray clay loam. The subsoil is grayish brown clay loam 10 inches thick. The substratum is mostly grayish brown clay loam to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is medium. Wind and water erosion is a moderate hazard.

The subsoil of the Elloam soil is moderately affected by sodium. When the subsoil is mixed with the surface layer, the surface tends to crust, which reduces seedling emergence and crop yields.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops. The main crops are barley, wheat, and oats.

Wind and water erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion. A permanent and adequately maintained cover

of planted grasses or of natural vegetation also helps control erosion.

These soils are well suited to use as rangeland. Most of the forage is produced on the Kevin soil. The potential plant community on the Kevin soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. The potential plant community on the Elloam soil consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, and greasewood. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, and Nuttall saltbush decrease and needleandthread, blue grama, fringed sagewort, prairie junegrass, and shrubby cinquefoil increase. Weedy plants likely to invade are annual grasses, broom snakeweed, plains pricklypear, and clubmoss.

On the Kevin soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds in unfavorable years. On the Elloam soil, forage production is 800 pounds per acre in favorable years and 300 pounds in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, allows desirable native plants to become reestablished, and thus forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. For the Kevin soil, suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac. For the Elloam soil, suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability in the Kevin soil and the very slow permeability in the Elloam soil limit these soils for most urban uses. Septic tank absorption fields require special design because of the slow and very slow permeability.

Capability subclass IVs, dryland. Kevin soil is in Silty range site, 10- to 14-inch precipitation zone; Elloam soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

74—Kevin-Hillon clay loams, 8 to 15 percent slopes. This complex consists of strongly rolling soils on glaciated uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Kevin soil makes up about 45 percent of the map unit, and the Hillon soil makes up about 45 percent. Included with these soils in mapping, and making up about 10 percent of the unit, are small areas of Elloam and Scobey soils. The Elloam soil is in sparsely vegetated, small depressions.

The Kevin soil is deep and well drained. It formed in glacial till on uplands. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Hillon soil is deep and well drained. It formed in glacial till on the tops of knolls and ridges. Typically, the surface layer is brown clay loam 4 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 26 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

These soils are used mainly as rangeland and for dryland crops. The main dryland crops are wheat, barley, and oats.

Wind and water erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

These soils are suited to use as rangeland. Most of the forage is produced on the Kevin soil. The potential plant community on the Kevin soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Forbs are decreasers. The potential plant community on the Hillon soil consists of western wheatgrass, bluebunch wheatgrass, neadleandthread, green needlegrass, prairie sandreed, and winterfat. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, bluebunch wheatgrass, winterfat, and green needlegrass decrease and needleandthread, blue grama, prairie junegrass, fringed sagewort, and threadleaf sedge increase. Weedy plants likely to invade are annual grasses, broom snakeweed, and clubmoss.

On the Kevin soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds in unfavorable years. On the Hillon soil, forage production is 900 pounds in favorable years and 300 pounds in unfavorable years.

Clubmoss is very competitive and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of slow permeability.

Capability subclass IVe, dryland. Kevin soil is in Silty range site, 10- to 14-inch precipitation zone; Hillon soil is in Thin Hilly range site, 10- to 14-inch precipitation zone.

75—Korent-Nesda complex, occasionally flooded. This complex consists of nearly level soils on stream terraces and flood plains. The elevation is 2,600 to 4,000 feet. Slopes are 0 to 2 percent. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Korent soil makes up about 40 percent of this map unit, and the Nesda soil makes up about 40 percent. Included with these soils in mapping, and making up about 20 percent of the map unit, are small areas of Farnuf and Straw soils.

The Korent soil is deep and well drained. It formed in alluvium. Typically, the surface layer is dark grayish brown silt loam 7 inches thick. The upper part of the substratum is brown silty clay loam 7 inches thick. The lower part is grayish brown sandy clay loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind and water erosion is a moderate hazard. This soil is subject to occasional flooding in spring.

The Nesda soil is deep and well drained. It formed in alluvium. Typically, the surface layer is grayish brown loam 7 inches thick. The subsurface layer is brown sandy loam 4 inches thick. The substratum is grayish brown, very gravelly loamy sand 4 inches thick. The lower part is pale brown, very gravelly sand to a depth of 60 inches.

Permeability is moderate to a depth of about 11 inches and rapid or very rapid below that. The available water capacity is very low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind and water erosion is a moderate hazard. Very gravelly sand is at a depth of less than 20 inches, which causes droughtiness. This soil is subject to occasional flooding in spring.

The soils in this complex are not suited to cultivated crops because of flooding. They are suited to use as rangeland, and they are used as rangeland. Most of the forage is produced on the Korent soil. The potential plant community on the Korent soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. The potential plant community on the Nesda soil consists mainly of bluebunch wheatgrass, green needlegrass, needleandthread, and western wheatgrass. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, fringed sagewort, needleandthread, blue grama, common snowberry, and big sagebrush increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, broom snakeweed, annual grasses, and Hood phlox.

On the Korent soil, the potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years. On the Nesda soil, forage production is 900 pounds in favorable years and 500 pounds in unfavorable years.

These soils can be used for windbreaks. Suitable trees for the Korent soil include Russian-olive, green ash, Siberian elm, white willow, golden willow, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac. Suitable trees for the Nesda soils include Russian-olive, Siberian crabapple, and ponderosa pine. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The hazard of occasional flooding limits these soils for most urban uses.

Capability subclass Vw, dryland. Korent soil is in Silty range site, 15- to 19-inch precipitation zone; Nesda soil is in Shallow to Gravel range site, 15- to 19-inch precipitation zone.

76—Lardell silty clay loam. This is a deep, somewhat poorly drained, nearly level soil on flood plains and stream terraces in valleys. It formed in alluvium. The elevation is 2,300 to 2,700 feet. Slopes are 0 to 2 percent and are mainly short. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is grayish brown silty clay loam 8 inches thick. The substratum, to a depth of 29 inches, is grayish brown silty clay loam, and below that, to a depth of 60 inches, it is light brownish gray loam stratified with thin lenses of fine sandy loam to silty clay

loam. When the soil is dry, many fine salt crystals are visible throughout the profile.

Permeability is slow, and the available water capacity is low because of the effect of salts. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is very strongly affected by salts and sodium. It is subject to rare flooding. The water table is at a depth of 12 to 60 inches in summer.

Small areas of Havre, Harlem, and Nobe soils are included with this soil in mapping. Also included, in small areas on the bottom lands of Woody Island Coulee, are soils that have a clayey subsoil and soils that have a very gravelly substratum at a depth of 30 to 60 inches.

The Lardell soil is not suited to cultivated crops because of the very strong effect of salts and sodium.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of alkali sacaton, basin wildrye, Nuttall alkaligrass, Nuttall saltbush, and greasewood. If the rangeland is overgrazed, basin wildrye, alkali sacaton, and Nuttall saltbush decrease; and inland saltgrass increases. Foxtail barley, curlycup gumweed, and kochia are likely to invade. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,200 pounds in unfavorable years.

The Lardell soil is not suitable for windbreaks because of the low available water capacity and the effect of salts and sodium.

The hazard of rare flooding and the water table limit this soil for most urban uses.

Capability subclass VIIw, dryland; Saline Lowland range site, 10- to 14-inch precipitation zone.

77—Lihen loamy fine sand, 0 to 6 percent slopes. This is a deep, well drained, undulating to gently rolling soil on terraces on uplands. It formed in alluvial and eolian material. The elevation is 2,400 to 3,000 feet. Slopes are mainly short. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is dark brown loamy fine sand 10 inches thick. The layer below that is brown loamy fine sand to a depth of 30 inches. The substratum, to a depth of 60 inches, is pale brown loamy fine sand.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is about 60 inches. The average wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard. This soil is droughty.

Small areas of Chinook and Vida soils are included with this soil in mapping.

The Lihen soil is used mainly as rangeland. In small areas it is used for dryland and irrigated crops. The main dryland crops are wheat, barley, and oats. The main irrigated crop is alfalfa hay.

Droughtiness and wind erosion are the main limitations to use of this soil for cultivated crops. Because of droughtiness, successful crop production depends on a suitable distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall grass barriers for trapping windblown snow help conserve moisture. Stripcropping, tall grass barriers, minimum tillage, and stubble mulch tillage can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps control erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, and needleandthread. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, Indian ricegrass and prairie sandreed decrease and needleandthread and green sagewort increase. Some woody plants are increasers. Weedy plants likely to invade are annual grasses and needleleaf sedge. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

This soil is suited to most urban uses. Because permeability is rapid, underground water supplies can be polluted by liquid and solid wastes from disposal systems.

Capability subclass IVe, dryland, and IVe, irrigated; Sands range site, 10- to 14-inch precipitation zone.

78—Lihen loamy fine sand, 6 to 12 percent slopes. This is a deep, well drained, gently rolling to strongly sloping soil on terraces on glaciated uplands. It formed in alluvial and eolian material. The elevation is 2,400 to 3,000 feet. Slopes are mainly short. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is dark brown loamy fine sand 10 inches thick. The layer below that is brown loamy fine sand to a depth of 30 inches. The substratum, to a depth of 60 inches, is pale brown loamy fine sand.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of this soil under native vegetation is 40 inches. Runoff is moderate. Wind erosion is a severe hazard, and water erosion is a moderate hazard. This soil is droughty.

Small areas of Chinook and Vida soils are included with this soil in mapping.

This soil is not suited to cultivated crops because of severe wind erosion, moderate water erosion, and droughtiness. A permanent and adequately maintained cover of natural vegetation helps control wind erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of Indian ricegrass, prairie sandreed, and needleandthread. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, Indian ricegrass and prairie sandreed decrease and needleandthread and fringed sagewort increase. Some woody plants are increasers. Weedy plants likely to invade are annual grasses and needleleaf sedge. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,000 pounds in unfavorable years.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

This soil is suited to most urban uses. Because permeability is rapid, underground water supplies can be polluted by liquid and solid wastes from disposal systems.

Capability subclass VIe, dryland; Sandy range site, 10- to 14-inch precipitation zone.

79—Lisam-Dilts clays, 8 to 35 percent slopes. This complex consists of strongly sloping to steep soils on uplands. The elevation is 2,400 to 4,000 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Lisam soil makes up about 45 percent of the map unit, and the Dilts soil makes up about 35 percent. Included with these soils in mapping, and making up about 20 percent of the unit, are small areas of Bascovy, Marvan, and Vanda soils and of shale outcrop.

The Lisam soil is shallow and well drained. It formed on side slopes of knolls and ridges in material that weathered from soft clayey shale. Typically, the surface layer is grayish brown clay 6 inches thick. The substratum is grayish brown clay and olive gray shaly clay 11 inches thick. Below that, to a depth of 60 inches, there is olive gray platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 17 inches. The average annual wetting depth of the soil under native vegetation is 17 inches. Runoff is medium to rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Soft clayey shale is at a depth of 10 to 20 inches.

The Dilts soil is shallow and well drained. It formed on side slopes of knolls and ridges in material that weathered from soft acid shale. Typically, the surface layer is grayish brown clay that is 3 inches thick and that has a thin, massive crust. The substratum is grayish brown clay and shaly clay 13 inches thick. Below that, to a depth of 60 inches, there is grayish brown platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 16 inches. The average annual wetting depth of the soil under native vegetation is 16 inches. Runoff is medium to rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Acid shale is at a depth of 10 to 20 inches.

The soils in this complex are not suited to cultivated crops because of the slope, the moderate hazard of wind erosion, the severe hazard of water erosion, and the very low available water capacity. A permanent and adequately maintained cover of natural vegetation helps control wind and water erosion.

These soils are suited to use as rangeland and are used as rangeland. The potential plant community consists mainly of bluebunch wheatgrass, green needlegrass, winterfat, western wheatgrass, and little bluestem. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass, green needlegrass, and western wheatgrass decrease and prairie junegrass, plains muhly, and big sagebrush increase. Some forbs are increasers. Weedy plants likely to invade are curlycup gumweed, broom snakeweed, and annual grasses. The potential plant community produces 1,000 pounds of forage per acre in favorable years and 500 pounds in unfavorable years.

The soils in this complex are very poorly suited to timber production. There are, however, a few ponderosa pine and limber pine trees of merchantable quality on the north and east aspects.

These soils are unsuited to use for windbreaks because of the very low available water capacity.

Slope and shallowness to shale limit these soils for most urban uses. Where slopes are less than 15 percent, septic tank absorption fields require special design because of the shallowness to shale. Where slopes are more than 15 percent, septic tank absorption fields require special design because of the slope and the shallowness to shale.

Capability subclass VIe, dryland; Shallow Clay range site, 10- to 14-inch precipitation zone.

80—Lisam-Dilts-Rock outcrop, shale complex, 25 to 60 percent slopes. This complex consists of steep soils and Rock outcrop on uplands (fig. 2). The elevation is 2,300 to 4,000 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Lisam soil makes up about 30 percent of the map unit, the Dilts soil makes up about 30 percent, and the shale outcrop about 30 percent. Included in mapping, and making up about 10 percent of the unit, are small areas of Bascovy, Marvan, and Vanda soil.

The Lisam soil is shallow and well drained. It formed on side slopes of hills and ridges in material that

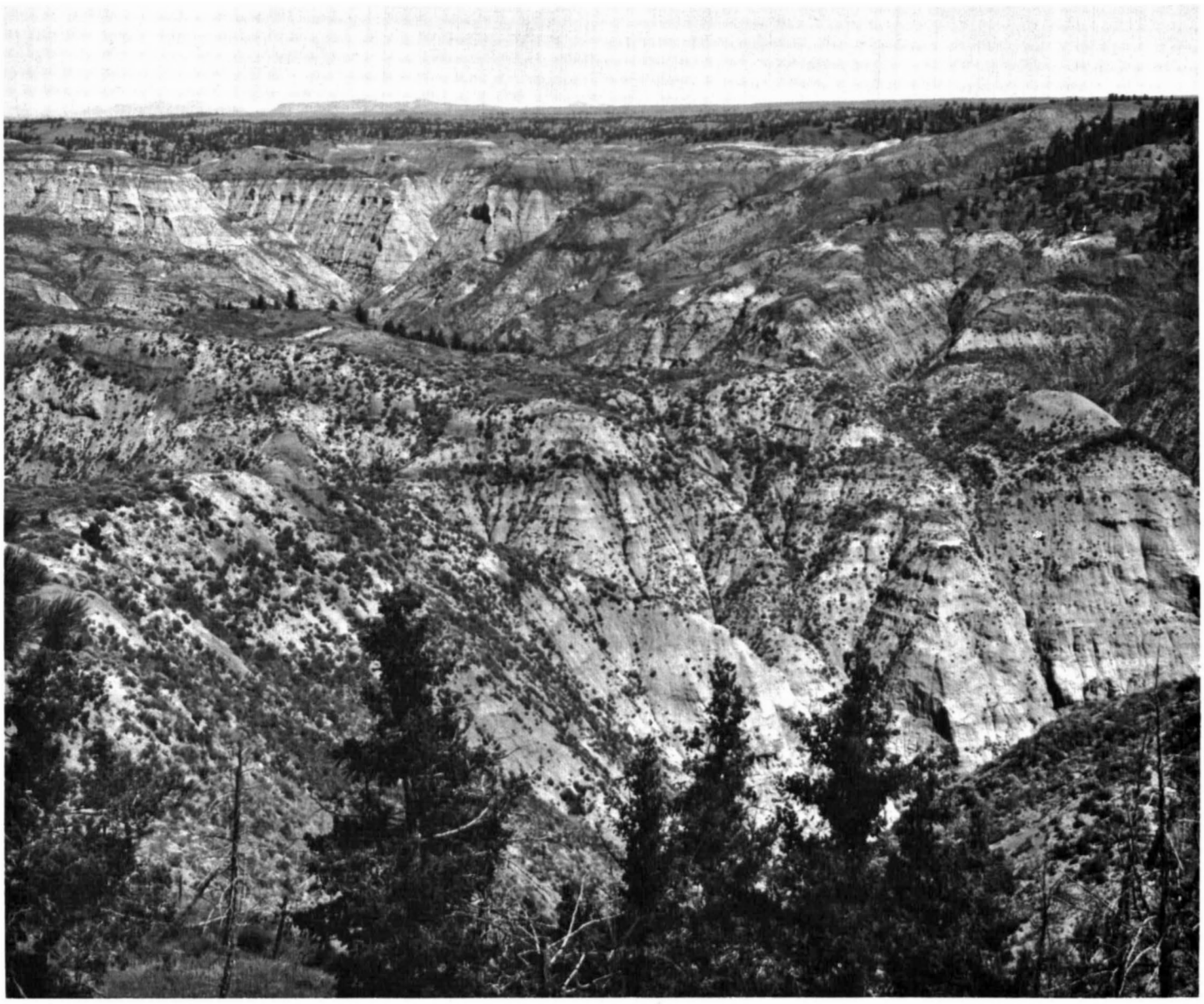


Figure 2.—Typical area of Lisam-Dilts-Rock outcrop, shale complex, 25 to 60 percent slopes. Sparse stands of ponderosa pine in the foreground are on Lisam-Dilts clays. Lisam-Dilts clays in the center have less moisture and support only grass and shrubs. The light-colored, steep, barren areas are Rock outcrop, shale.

weathered from soft clayey shale. Typically, the surface layer is grayish brown clay 6 inches thick. The substratum is grayish brown clay and olive gray shaly clay 11 inches thick. Below that, to a depth of 60 inches, there is olive gray soft platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 17 inches. The average annual wetting depth of the soil under native vegetation is 17 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Soft clayey shale is at a depth of 10 to 20 inches.

The Dilts soil is shallow and well drained. It formed on side slopes of hills and ridges in material that weathered from soft acid shale. Typically, the surface layer is grayish brown clay that is 3 inches thick and that has a thin, massive crust. The substratum is grayish brown soft platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 16 inches. The average annual wetting depth of the soil

under native vegetation is 16 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Soft platy acid shale is at a depth of 10 to 20 inches.

Rock outcrop, shale, consists of exposed beds of mainly grayish brown or gray clay shale on hillsides, ridges, and knolls and along drainageways. Runoff is rapid. Water erosion is a severe hazard.

The soils in this complex are not suited to cultivated crops because of slope, the moderate hazard of wind erosion, the severe hazard of water erosion, the very low available water capacity, and the outcropping of shale. A permanent and adequately maintained cover of natural vegetation helps control wind and water erosion.

These soils are suited to use as rangeland, and they are used as rangeland. Most of the forage is produced on the Lisam and Dilts soils. Steep and very steep slopes make livestock grazing difficult. The potential plant community consists mainly of bluebunch wheatgrass, western wheatgrass, green needlegrass, little bluestem, and winterfat. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass, western wheatgrass, green needlegrass, and winterfat decrease and prairie junegrass, plains muhly, and big sagebrush increase. Some forbs are increasers. Weedy plants likely to invade are broom snakeweed, curlycup gumweed, and foxtail barley. The potential plant community produces 1,000 pounds of forage per acre in favorable years and 500 pounds in unfavorable years.

The soils in this complex are very poorly suited to timber production. There are, however, a few ponderosa pine and limber pine trees of merchantable quality on the north and east aspects.

The rate of tree growth on these soils is less than 35 cubic feet per acre per year. Existing stands are of limited commercial value; they should be maintained for watershed protection and for wildlife habitat.

The soils in this complex are not suited to windbreaks because of slope.

Steep and very steep slopes and shallowness to shale limit these soils for most urban uses.

Capability subclass VIIe, dryland; Shallow Clay range site, 10- to 14-inch precipitation zone.

81—Lisam-Hillon association, steep. This association consists of soils on uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Lisam soil makes up about 50 percent of the mapping unit, and the Hillon soil makes up about 35 percent. Included in mapping, and making up about 15 percent of the unit, are small areas of Bascovy, Kevin, Marvan, and Vanda soil and of shale outcrop.

The Lisam soil is shallow and well drained. It formed on lower side slopes of hills and ridges in material that weathered from soft clayey shale. Typically, the surface layer is grayish brown clay 6 inches thick. The substratum is grayish brown clay and olive gray shaly clay 11 inches thick. Below that, to a depth of 60 inches, there is olive gray platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 17 inches. The average annual wetting depth of the soil under native vegetation is 17 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. The depth to soft clayey shale is 10 to 20 inches.

The Hillon soil is deep and well drained. It is on upper side slopes of hills and ridges and formed in glacial till. Typically, the surface layer is brown clay loam 4 inches thick. The substratum, to a depth of 60 inches or more, is grayish brown clay loam.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 26 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

The soils in this association are not suited to cultivated crops because of the steep slopes, the moderate hazard of wind erosion, and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps control wind and water erosion.

These soils are suited to use as rangeland, and they are used as rangeland. The potential plant community on the Lisam soil consists mainly of western wheatgrass, bluebunch wheatgrass, green needlegrass, little bluestem, winterfat, and greasewood. Forbs are decreasers. The potential plant community on the Hillon soil consists mainly of western wheatgrass, little bluestem, needleandthread, green needlegrass, and prairie sandreed. Forbs are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, and bluebunch wheatgrass decrease and needleandthread, blue grama, threadleaf sedge, prairie junegrass, plains muhly, and big sagebrush increase. Weedy plants likely to invade are broom snakeweed, curlycup gumweed, and annual grasses.

On the Lisam soil, the potential plant community produces 1,000 pounds of forage per acre in favorable years and 500 pounds in unfavorable years. On the Hillon soil, forage production is 900 pounds per acre in favorable years and 400 pounds in unfavorable years.

The soils in this association are not suitable for windbreaks because of the steep slopes.

Slope and shallowness to shale on the Lisam soil limit these soils for most urban uses.

Capability subclass VIe, dryland. Lisam soil is in Shallow Clay range site, 10- to 14-inch precipitation zone; Hillon soil is in Thin Hilly range site, 10- to 14-inch precipitation zone.

82—Lisam-Wabek association, steep. This association consists of soils on uplands. The elevation is

2,800 to 4,000 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Lisam soil makes up about 55 percent of the map unit, and the Wabek soil makes up 30 percent. Included with these soils in mapping, and making up 15 percent of the unit, are small areas of Marvan and Bascovy soils and areas of shale outcrop.

The Lisam soil is shallow and well drained. It formed on the side slopes of hills and ridges in material that weathered from soft clayey shale. Typically, the surface layer is grayish brown clay 6 inches thick. The substratum is grayish brown clay and olive gray shaly clay 11 inches thick. Below that, to a depth of 60 inches, there is olive gray platy shale that rubs to clay or clay loam.

Permeability is slow, and the available water capacity is very low. The effective rooting depth is about 17 inches. The average annual wetting depth of the soil under native vegetation is 17 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Soft clayey shale is at a depth of 10 to 20 inches.

The Wabek soil is deep and well drained. It is on the upper part of slopes on the edges of outwash terraces and crests of ridges. It formed in alluvium. Typically, the surface layer is mainly dark brown gravelly loam 8 inches thick. The upper part of the substratum is light brownish gray very gravelly loamy coarse sand 7 inches thick. The lower part, to a depth of 60 inches, is grayish brown very gravelly coarse sand.

Permeability is moderately rapid to a depth of about 8 inches and very rapid below that. The available water capacity is very low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The soils in this association are not suited to cultivated crops because of slope.

The soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Lisam soil. The potential plant community on the Lisam soil consists mainly of bluebunch wheatgrass, western wheatgrass, little bluestem, green needlegrass, and winterfat. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, bluebunch wheatgrass, western wheatgrass, prairie sandreed, green needlegrass, and little bluestem decrease; prairie junegrass, plains muhly, big sagebrush, blue grama, prairie junegrass, and fringed sagewort increase; and annual grasses, clubmoss, red threeawn, broom snakeweed, and curlycup gumweed invade.

On the Lisam soil, the potential plant community produces 1,000 pounds of forage per acre in favorable years and 500 pounds per acre in unfavorable years. On the Wabek soil, forage production is 900 pounds per acre in favorable years and 500 pounds in unfavorable years.

The soils in this association are very poorly suited to timber production. There are, however, a few ponderosa pine and limber pine trees of merchantable quality on the north and south aspects.

The soils are not suited to windbreaks because of the steep slopes.

The steep slopes limit these soils for most urban uses.

Capability subclass VIe, dryland. Lisam soil is in Shallow to Clay range site, 10- to 14-inch precipitation zone; Wabek soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone.

83—Lolo loam. This is a deep, well drained, nearly level to gently sloping soil on fans and stream terraces in mountain valleys. It formed in alluvium. The elevation is 3,000 to 4,500 feet. Slopes are 0 to 4 percent and are mainly short. The average annual precipitation is 16 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the upper part of the surface layer is very dark grayish brown loam 6 inches thick. The lower part is dark grayish brown gravelly loam 16 inches thick. The subsoil is grayish brown very gravelly sandy loam 16 inches thick. The substratum is very gravelly sandy loam to a depth of 60 inches.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is about 40 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Small areas of Nesda, Korent, and Straw soils are included with this soil in mapping. The Nesda soil is gently sloping and is along stream channels.

The Lolo soil is used as rangeland and for irrigated crops. The main crops are barley and alfalfa for hay.

Droughtiness and wind erosion are the main limitations to use of this soil for cultivated crops. Because of droughtiness, successful crop production depends on a suitable distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall grass barriers for trapping windblown snow help conserve moisture. Stripcropping, tall grass barriers, minimum tillage, and stubble mulch tillage can effectively control wind erosion. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, basin wildrye, and ponderosa pine. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox,

pussytoes, and clubmoss. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses. Because permeability is moderately rapid, underground water supplies can be polluted by liquid and solid wastes from disposal systems.

Capability subclass IVe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

84—Macmeal association, steep. The soils in this association are mainly in the Little Rocky Mountains. The elevation is 4,000 to 6,000 feet. The average annual precipitation is 19 inches, and the average annual temperature is 40 degrees F. The average growing season is 90 days.

Macmeal soil, south aspect, makes up about 55 percent of the association; Macmeal soil, north aspect, makes up about 35 percent. Included in mapping, and making up about 10 percent of the unit, are small areas of Castner and Silverchief soils and of Rock outcrop. The steep, shallow Castner soil and the Rock outcrop are on ridges and hills. The moderately sloping to steep Silverchief soil is on foot slopes and fans.

Macmeal soils are deep and well drained. They formed in colluvium or alluvium that weathered from igneous and metamorphic rock on mountainsides. Macmeal soil, north aspect, has a higher effective moisture regime than Macmeal soil, south aspect.

Typically, the surface layer of the Macmeal soil, north aspect, is covered by an organic mat 2 inches thick. The surface layer is pale brown gravelly loam 7 inches thick. The upper part of the subsoil is yellowish brown very gravelly clay loam 7 inches thick. The middle part is yellowish brown extremely channery clay loam 34 inches thick. The lower part is brown, extremely flaggy clay loam to a depth of 60 inches.

Typically, the surface layer of the Macmeal soil, south aspect, is light brownish gray gravelly loam 2 inches thick. The subsurface layer is pale brown gravelly loam 3 inches thick. The upper part of the subsoil is yellowish brown very gravelly clay loam 9 inches thick. The middle part, to a depth of 48 inches is yellowish brown, extremely channery clay loam 34 inches thick. The lower part is brown, extremely flaggy clay loam to a depth of 60 inches.

Permeability is moderately slow. The available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of these soils under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

A permanent and adequately maintained cover of natural vegetation helps control wind and water erosion.

The Macmeal soils are suitable for use as woodland. The vegetation on these soils was altered in 1936 by a fire that burned most of the trees in the Little Rocky Mountains. Forests of lodgepole pine and some Douglas-fir regenerated on nearly all of the north and east slopes. Grasses and shrubs cover the south and west slopes and protect the soils from erosion. This vegetation is in strong competition with emerging trees for moisture and nutrients and has delayed the reestablishment of forests on the south and west slopes. However, there are scattered stands of trees, mainly ponderosa pine.

The soils in this association are used as rangeland and woodland. The potential forest understory plant community on north and east slopes consists mainly of pinegrass, common snowberry, Oregongrape, bearded wheatgrass, Columbia needlegrass, blue wildrye, common juniper, arrowleaf balsamroot, white spirea, common chokecherry, russet buffaloberry, twinflower, heartleaf arnica, kinnikinnick, and lupine. The forest understory on south and west slopes consists mainly of bluebunch wheatgrass, Saskatoon serviceberry, little bluestem, skunkbush sumac, and common snowberry. If the forest overstory becomes less dense, the amount of forage produced in the understory increases and the composition of the understory changes. If the rangeland is overgrazed, Columbia needlegrass, bluebunch wheatgrass, and blue wildrye decrease and common snowberry, arrowleaf balsamroot, and lupine increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, and cheatgrass.

The potential native plant community of the nonforested Macmeal soils is similar to that of the forest understory on south and west slopes.

The soils in this association are not suited to windbreaks because the slopes are more than 15 percent.

The Macmeal soil, north aspect, is suited to the production of Douglas-fir and lodgepole pine. It is capable of producing about 4,495 total cubic feet, or 11,510 board feet (Scribner rule), per acre of Douglas-fir and 6,510 total cubic feet, or 17,221 board feet, per acre of lodgepole pine. The Macmeal soil, south aspect, is suited to the production of ponderosa pine. It is capable of producing about 4,325 total cubic feet, or 10,450 board feet (Scribner rule), per acre of ponderosa pine. These production levels are from fully stocked, even-aged, unmanaged stands of 100-year-old trees.

The main restrictions to use of these soils for timber production are steep slopes, clay in the subsoil, and low available water capacity. Steep slopes limit the use of equipment in forest management. To reduce soil erosion, logs should not be skidded in drainageways. Various trails should be used in skidding operations to prevent

deeply rutted paths from forming. Clay in the subsoil reduces trafficability in wet seasons. The low available water capacity limits regeneration and increases seedling mortality. Site scarification during harvest and regeneration is necessary to reduce plant competition and seedling mortality.

The steep and very steep slopes limit these soils for most urban uses.

Capability subclass VIIe, dryland.

85—Marmarth-Cabbart complex, 2 to 8 percent slopes. This complex consists of Marmarth and Cabbart soils on uplands. These soils are at an elevation of 2,800 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Marmarth soil makes up about 50 percent of the map unit, and the Cabbart soil makes up 35 percent. Included with these soils in mapping, and making up about 15 percent of the unit, are small areas of Delpoint, Ethridge, Marvan, and Riedel soils and small areas of Rock outcrop. Ethridge soils are nearly level and gently sloping, and Marvan soils are moderately affected by sodium. These soils are on lower slopes. Rock outcrop consists of ridges and knolls. Riedel soils are undulating and gently rolling and shallow. They are on knolls and ridges.

The Marmarth soil is moderately deep and well drained. It formed on the lower part of the slope in material that weathered from soft siltstone. Typically, the surface layer is dark brown clay loam 6 inches thick. The upper part of the subsoil is brown clay loam 8 inches thick. The lower part is grayish brown clay loam 4 inches thick. The substratum is light brownish gray sandy clay loam 12 inches thick. Below that, to a depth of 60 inches, there is soft siltstone and thin strata of soft sandstone. The soft sedimentary beds rub to loam.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is about 30 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion are moderate hazards. The soft sedimentary beds are at a depth of 20 to 40 inches.

The Cabbart soil is shallow and well drained. It formed on knolls and ridges in material that weathered from soft siltstone. Typically, the surface layer is grayish brown loam 4 inches thick. The substratum is grayish brown loam 8 inches thick. Below that, to a depth of 60 inches, there is soft siltstone that rubs to loam, silt loam, or clay loam.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 12 inches. The average annual wetting depth of the soil under native vegetation is 12 inches. Runoff is medium. Wind and water erosion are moderate hazards. The depth to soft sedimentary beds ranges from 10 to 20 inches.

The soils in this complex are used for dryland crops and as rangeland. The main dryland crops are wheat, barley, and oats. Wind and water erosion are the main limitations to use of these soils for cultivated crops. The Cabbart soil, in addition, is droughty. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

These soils are suited to use as rangeland. The bulk of the forage is produced on the Marmarth soil. The potential plant community on the Marmarth soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, and silver sagebrush. Some forbs are decreasers. The potential plant community on the Cabbart soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, western wheatgrass, green needlegrass, bluebunch wheatgrass, and needleandthread decrease; blue grama, prairie junegrass, and fringed sagewort increase; and annual grasses, broom snakeweed, and needleleaf sedge invade.

On the Marmarth soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Cabbart soil, forage production is 800 pounds per acre in favorable years and 400 pounds per acre in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The Cabbart and Marmarth soils can be used for windbreaks. The choice of trees and shrubs, however, is restricted to those that are drought resistant because of the moderate and very low available water capacity. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

The soft siltstone at a depth of 20 to 40 inches in the Marmarth soil and the soft siltstone at a depth of 10 to 20 inches in the Cabbart soil are limitations for most urban uses. Septic tank absorption fields on these soils require special design because of the siltstone.

Capability subclass IVe, dryland. Marmarth soil is in Silty range site, 10- to 14-inch precipitation zone; Cabbart soil is in Shallow range site, 10- to 14-inch precipitation zone.

86—Martinsdale clay loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil on terraces and fans on uplands. It formed in alluvium. The elevation is 3,200 to 4,500 feet. Slopes are mainly long. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days. Typically, the surface layer, where it is mixed to a depth

of about 7 inches, is dark brown clay loam. The subsoil is mostly brown clay loam 6 inches thick. The substratum is light gray and pale brown clay loam to a depth of 54 inches; below that, it is pale brown gravelly clay loam to a depth of 60 inches.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 40 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Judith, Turner, and Work soils are included in mapping. The Turner soil is nearly level to gently sloping, and the Judith soil is gently sloping. These soils are on the upper part of low ridges and knolls.

The Martinsdale soil is used for dryland crops and as rangeland. The main dryland crops are wheat, oats, and barley. Wind erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Some sedges, forbs, and woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye and an increase of plants such as Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and big sagebrush. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. The high content of lime at a depth of about 13 inches limits the choice of trees and shrubs to those that are tolerant of lime. Suitable trees include Russian-olive, green ash, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

The moderately slow permeability of this soil is a limitation for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

87—Martinsdale-Judith complex, 2 to 8 percent slopes. This complex consists of undulating to gently rolling soils on terraces and fans on uplands. The elevation is 3,200 to 4,500 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Martinsdale soil makes up about 50 percent of this map unit, and the Judith soil makes up 40 percent. Included in mapping are small areas of Windham and Work soils. These soils make up about 10 percent of the map unit. The Windham soil is strongly sloping. It is on ridges and on the edge of terraces.

The Martinsdale soil is deep and well drained. It formed in alluvium on the lower part of slopes. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is dark brown clay loam. The subsoil is mostly brown clay loam 6 inches thick. The substratum is light gray and pale brown clay loam to a depth of 54 inches; below that, it is pale brown gravelly clay loam to a depth of 60 inches.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 40 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow or medium. Wind and water erosion are moderate hazards.

The Judith soil is deep and well drained. It formed in alluvium on the upper part of slopes on ridges and knolls. Typically, the surface layer is dark grayish brown loam 5 inches thick. The substratum is pale brown and very pale brown loam to a depth of 33 inches; below that, it is very pale brown very gravelly loam to a depth of 60 inches or more.

Permeability is moderate to a depth of about 33 inches and moderately rapid below that depth. The available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow or medium. Wind and water erosion are moderate hazards. This soil is calcareous, and yields from cultivated crops are low.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops, mainly wheat, oats, and barley. Wind and water erosion are the main limitations to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

The soils in this complex are suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. Continued excessive

grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye and an increase of plants such as Idaho fescue, needleandthread, western wheatgrass, prairie junegrass, bluegrass, fringed sagewort, common snowberry, and big sagebrush. Weedy plants likely to invade are clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. The high content of lime at a shallow depth limits the choice of trees and shrubs to those that are tolerant of lime. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, lilac, and skunkbush sumac.

The moderately slow permeability of the Martinsdale soil is a limitation for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability. Because permeability in the substratum of the Judith soil is moderately rapid, ground water can be polluted by liquid and solid wastes from sanitary disposal systems.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

88—Marvan clay, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil. It formed in clayey alluvium on fans and terraces in valleys and on uplands (fig. 3). The elevation is 2,300 to 3,000 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown clay 7 inches thick. The substratum is grayish brown clay to a depth of 23 inches and, below that, grayish brown silty clay to a depth of 60 inches.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Harlem, Ethridge, and Vanda soils are included with this soil in mapping. The Vanda soil is level to gently sloping. It is in sparsely vegetated areas, and it is strongly affected by sodium.

The Marvan soil is used mainly as rangeland. In some areas it is used for irrigated and dryland crops. The main irrigated crops are alfalfa for hay, wheat, and barley. The

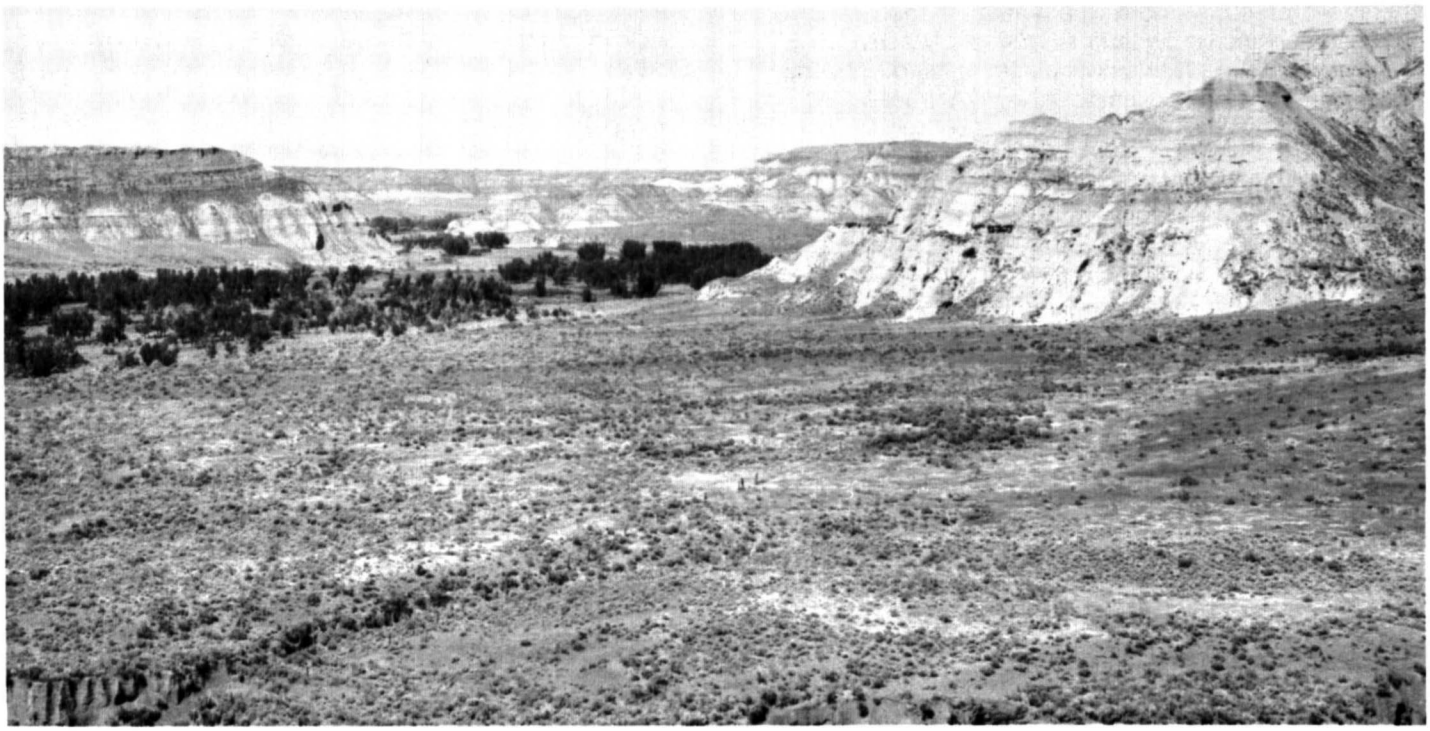


Figure 3.—Marvan clay on the alluvial fan in the foreground; Rock outcrop, shale, in the background; and Havre loam along Cow Creek.

main dryland crops are wheat and barley. Wind erosion and a moderate content of sodium are the main limitations to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

The Marvan soil is suited to use as rangeland. The potential plant community consists mainly of green needlegrass, Nuttall saltbush, winterfat, and forbs. If the rangeland is overgrazed, green needlegrass and western wheatgrass decrease and Sandberg bluegrass, blue grama, threadleaf sedge, silver sagebrush, prairie junegrass, and fringed sagewort increase. Weedy plants that are likely to invade are clubmoss, annual grasses, and curlycup gumweed. Forage production is 1,300 pounds per acre in favorable years and 700 pounds per acre in unfavorable years.

This soil can be used for windbreaks. Because the soil is moderately affected by sodium, the choice of shrubs and trees is restricted to those that are resistant to sodium. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry.

The high shrink-swell potential, low strength, and very slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the very slow permeability. Foundations and basements for houses require special design because of the high shrink-swell potential and low soil strength.

Capability subclass IVs, dryland, and IVe, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

89—Marvan-Bascovy clays, 2 to 8 percent slopes. This complex consists of gently sloping to moderately sloping Marvan and Bascovy soils on uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Marvan soil makes up about 45 percent of the map unit, and the Bascovy soil makes up 40 percent. Included with these soils in mapping, and making up 15 percent of the map unit, are small areas of Dilts, Lisam, and Vanda soils and areas of shale outcrop. The moderately sloping and moderately steep Dilts and Lisam soils are on the top of ridges and knolls. They are shallow soils. The gently sloping Vanda soil is in sparsely vegetated areas and is strongly affected by sodium.

The Marvan soil is deep and well drained. It formed in clayey alluvium on fans and the lower part of slopes. Typically, the surface layer is grayish brown clay 7 inches thick. The substratum is grayish brown clay to a depth of 23 inches and, below that, grayish brown silty clay to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Bascovy soil is moderately deep and well drained. It formed on knolls, ridges, and the upper part of slopes in material that weathered from soft shale. Typically, the surface layer is grayish brown clay 6 inches thick. There is a very thin light brownish gray vesicular crust on the surface. The subsoil is olive gray clay 9 inches thick. The substratum is olive gray clay 8 inches thick. Below the substratum, to a depth of 60 inches, there is olive gray and olive brown, soft clayey shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 23 inches. The average annual wetting depth of the soil under native vegetation is 23 inches. Runoff is medium. Wind and water erosion are moderate hazards. The depth to soft clayey shale ranges from 20 to 40 inches.

Because the Marvan soil is moderately affected by sodium and the Bascovy soil is droughty, the suitability for cultivated crops is poor.

The soils in this complex are suited to use as rangeland and are used as rangeland. The potential plant community on the Marvan and Bascovy soils consists mainly of western wheatgrass, green needlegrass, Canby bluegrass, Nuttall saltbush, winterfat, and forbs. If the rangeland is overgrazed, green needlegrass, Canby bluegrass, and western wheatgrass decrease and Sandberg bluegrass, prairie junegrass, big sagebrush, and fringed sagewort increase. Weedy plants that are likely to invade are clubmoss, annual grasses, and curlycup gumweed. The potential plant community produces 1,300 pounds of forage per acre in favorable years and 700 pounds per acre in unfavorable years.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Because the Marvan soil is moderately affected by sodium and the Bascovy soil is droughty, the choice of shrubs and trees is restricted. On the Marvan soil, suitable trees include Russian-olive and Siberian elm, and suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry. On the Bascovy soil, suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The high shrink-swell potential, low strength, and very slow permeability of the soils in this complex are limitations for urban uses. Soft shale at a depth of 20 to 40 inches in the Bascovy soil is an additional limitation. Septic tank absorption fields require special design because of the very slow permeability. Foundations and basements for houses require special design because of the high shrink-swell potential and low strength.

Capability subclass IVs, dryland; Clayey range site, 10- to 14-inch precipitation zone.

90—Nishon loam. This is a deep, somewhat poorly drained, nearly level soil in closed basins on glaciated uplands. It formed in alluvium. The elevation is 2,500 to 3,300 feet. Slopes are 0 to 1 percent. The average annual precipitation is 13 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is light brownish gray loam 12 inches thick. The subsoil is grayish brown clay 9 inches thick. The substratum is olive clay to a depth of 16 inches and, below that, pale olive clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 60 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. The soil is subject to ponding in spring and summer. The water table is at a depth of 6 to 36 inches in summer.

Small areas of Dimmick soil are included in mapping. The Dimmick soil is level to nearly level; it is in the lower part of the basins.

The Nishon soil is used for dryland farming and as rangeland. The main crops are wheat and barley.

Ponding and wetness are the main limitations to use of this soil for cultivated crops. Ponding delays the seeding or harvesting of crops in most years.

This soil is suited to use as rangeland. The potential plant community consists mainly of basin wildrye, green needlegrass, western wheatgrass, and Canby bluegrass. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, basin wildrye and green needlegrass decrease and western wheatgrass, sedges, and silver sagebrush increase. Woody plants, Kentucky bluegrass, and annual plants are likely to invade. Forage production is 2,000 pounds per acre in favorable years and 1,200 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Windbreak species that are tolerant of frequent wetness should be used. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, and white and golden willow. Suitable shrubs include common chokecherry, lilac, and American plum.

Ponding and wetness limit the use of this soil for most urban uses.

Capability subclass IIIw, dryland; Overflow range site, 15- to 19-inch precipitation zone.

91—Nishon clay loam. This is a deep, poorly drained, nearly level soil in closed basins on glaciated uplands. It formed in alluvium. The elevation is 2,500 to 3,300 feet. Slopes are 0 to 1 percent. The average annual precipitation is 13 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is light brownish gray clay loam 5 inches thick. The subsoil is mostly gray clay, and the substratum, to a depth of 60 inches, is also gray clay.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 60 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard. The soil is subject to ponding in spring and in summer. The water table is at a depth of 6 to 36 inches in summer.

Small areas of Dimmick soils are included in mapping. The Dimmick soil is nearly level. It is in the lower part of closed basins, and it too is subject to ponding.

The Nishon soil is poorly suited to use as cropland because of ponding and wetness. Ponding delays the seeding or harvesting of a crop about half of the time.

This soil is suited to use as rangeland and is used mainly as rangeland. The potential plant community consists mainly of basin wildrye, green needlegrass, western wheatgrass, Canby bluegrass, and slender wheatgrass. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as basin wildrye and green needlegrass and an increase of western wheatgrass, sedges, and silver sagebrush. Woody plants, Kentucky bluegrass, and annual plants are likely to invade. The potential plant community produces 2,000 pounds of forage per acre in favorable years and 1,200 pounds in unfavorable years.

This soil can be used for windbreaks; however, it is subject to prolonged wetness, so only those trees and shrubs that are tolerant of wetness should be used. Suitable trees include Russian-olive, Siberian elm, white willow, and golden willow. Suitable shrubs include common chokecherry and silver buffaloberry.

The ponding and wetness limit this soil for most urban uses.

Capability subclass IVw, dryland; Overflow range site, 15- to 19-inch precipitation zone.

92—Norbert clay, 8 to 35 percent slopes. This is a shallow, well drained, strongly sloping to steep soil on uplands. It formed in material that weathered from soft clayey shale. The elevation is 2,500 to 4,400 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is olive gray clay 10 inches thick. The substratum is olive gray very shaly clay 4 inches thick. Below that, to a depth of 60 inches, there is soft platy shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is very low. The effective rooting depth is about 14 inches. The average annual wetting depth of the soil under native vegetation is 14 inches. Runoff is rapid.

Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth to soft platy shale is 10 to 20 inches.

Small areas of Barkof and Marvan soils and areas of shale outcrop are included in mapping. The shale outcrop is on top of some knolls and ridges and in eroded areas along drainageways.

The Norbert soil is not suited to cultivated crops because of its very low available water capacity, the shallowness to platy shale, the severe hazard of water erosion, and the steepness of the slope. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of bluebunch wheatgrass, green needlegrass, western wheatgrass, and winterfat. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass, green needlegrass, and winterfat and an increase of plants such as western wheatgrass, Sandberg bluegrass, plains reedgrass, and fringed sagewort. Annual grasses, broom snakeweed, Hood phlox, and rubber rabbitbrush are likely to invade. Forage production is 1,600 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The high shrink-swell potential, slope, very slow permeability, and shallowness to shale limit this soil for most urban uses. Septic tank filter fields on this soil require special design because of the very slow permeability, slope, and shallowness to shale.

Capability subclass VIe, dryland; Shallow Clay range site, 15- to 19-inch precipitation zone.

93—Norbert-Rock outcrop, shale complex, 25 to 60 percent slopes. This complex consists of steep Norbert soil and steep to very steep Rock outcrop, shale, on uplands. The elevation is 2,500 to 4,400 feet. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Norbert soil makes up about 60 percent of this map unit, and Rock outcrop, shale, makes up 30 percent. Included in mapping, and making up about 10 percent of the map unit, are small areas of Barkof, Marvan, and Vanda soils.

The Norbert soil is shallow and well drained. It formed on the upper slopes of hills, knolls, and ridges in material that weathered from soft clayey shale. Typically, the surface layer is olive gray clay 10 inches thick. The substratum is olive gray very shaly clay 4 inches thick. Below that, to a depth of 60 inches, there is platy shale that rubs to clay or clay loam.

Permeability is very slow, and the available water capacity is very low. The effective rooting depth is about 14 inches. The average annual wetting depth of the soil under native vegetation is 14 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Soft shale is at a depth of 10 to 20 inches.

Rock outcrop, shale, is on the side of hills and eroded drainageways.

The soils in this complex are not suited to cultivated crops because of the steep slopes, the severe hazard of water erosion, and the shallowness to platy shale. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

These soils are suited to use as rangeland and are used as rangeland, although the steep and very steep slopes make grazing difficult for livestock. The potential plant community on the Norbert soil consists mainly of bluebunch wheatgrass, western wheatgrass, green needlegrass, winterfat, and plains muhly. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass, winterfat, green needlegrass, and forbs and an increase of Idaho fescue, needleandthread, blue grama, and fringed sagewort. Weedy plants that are likely to invade are annual grasses, Kentucky bluegrass, broom snakeweed, and pussytoes. Forage production on the Norbert soil is 1,600 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The soils are very poorly suited to timber production. There are, however, a few ponderosa pine, limber pine, and Douglas-fir trees of merchantable quality on north-facing slopes. There are also a few ponderosa pine and limber pine trees of merchantable quality on south-facing slopes.

These soils are not suited to windbreaks because of the steep slopes and the very low available water capacity.

The steep and very steep slopes, shrink-swell potential, and shallowness to shale limit these soils for most urban uses.

Capability subclass VIIe, dryland; Norbert soil is in Shallow Clay range site, 15- to 19-inch precipitation zone.

94—Perma-Castner-Belain complex, 25 to 60 percent slopes. This complex consists of steep to very steep Perma and Castner soils and steep Belain soil on hills, ridges, and mountains. The elevation is 3,000 to 6,000 feet. The average annual precipitation is 17 inches, and the average annual temperature is 42 degrees F. The average growing season is 105 days.

The Perma soil makes up about 40 percent of the map unit, the Castner soil makes up 25 percent, and the Belain soil makes up 20 percent. Included with these soils in mapping are small areas of Hedoes soil and areas of Rock outcrop. These included areas make up about 15 percent of the map unit.

The Perma soil is deep and well drained. It formed on the lower part of steep slopes in colluvium or alluvium of igneous rock and hard sandstone. Typically, the surface layer is very dark grayish brown gravelly loam and dark grayish brown, very gravelly loam 11 inches thick. The

subsoil is brown, very gravelly loam 29 inches thick. The substratum, to a depth of 60 inches, is grayish brown, very gravelly loam (fig. 4).

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Castner soil is shallow and well drained. It formed on ridges, hills, and mountains in material that weathered from hard sandstone and hard igneous rock. Typically, the surface layer is dark grayish brown gravelly loam 6 inches thick. The substratum is brown very channery loam 7 inches thick. Hard bedrock is at a depth of 13 inches.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 13 inches. The average annual wetting depth of the soil under native vegetation is 13 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. Bedrock is at a depth of 10 to 20 inches.

The Belain soil is moderately deep and well drained. It formed on the upper part of slopes in material that weathered from hard igneous rock. Typically, the surface layer is dark grayish brown loam 4 inches thick. The subsoil is dark brown loam and gravelly loam 11 inches thick. The substratum is brown gravelly loam and very gravelly loam 13 inches thick. Igneous bedrock is at a depth of 28 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is rapid. Water erosion is a severe hazard, and wind erosion is a moderate hazard. The depth to hard rock is 20 to 40 inches.

The soils in this complex are not suited to cultivated crops because of the steep slopes and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps control water erosion.

The soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Perma and Belain soils. The potential plant community on the Perma and Belain soils consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. On the Castner soil the potential plant community consists mainly of bluebunch wheatgrass, rough fescue, green needlegrass, Idaho fescue, needleandthread, and Rocky Mountain juniper. Some forbs and woody plants are decreasers. If the rangeland is overgrazed, rough fescue and bluebunch wheatgrass decrease; Idaho fescue, common snowberry, Woods rose, common chokecherry, needleandthread, blue grama, prairie junegrass, and fringed sagewort increase; and clubmoss, annual grasses, broom snakeweed, and pussytoes invade.

On the Perma soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years. On the Castner soil, forage production is 1,200 pounds per acre in favorable years and 700 pounds per acre in unfavorable years. On the Belain soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The soils in this complex are poorly suited to timber production. There are, however, a few ponderosa pine and Douglas-fir trees of merchantable quality on north-facing slopes.

The soils in this complex are not suited to windbreaks because slopes are more than 15 percent.

The steep slopes limit these soils for most urban uses.

Capability subclass VIIe, dryland. Perma soil is in Thin Hilly range site, 15- to 19-inch precipitation zone; Castner soil is in Shallow range site, 15- to 19-inch precipitation zone; and Belain soil is in Thin Hilly range site, 15- to 19-inch precipitation.

Figure 4.—Profile of Perma gravelly loam showing the very gravelly substratum.

95—Phillips loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to undulating soil that formed in glacial till on uplands. The elevation is 2,400 to 3,600 feet. Slopes are mainly long. The average annual

precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is brown loam 2 inches thick. The subsurface layer is pale brown and light brownish gray loam 5 inches thick. The subsoil is brown clay and grayish brown clay loam 15 inches thick. The substratum is grayish brown clay loam to a depth of 78 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Elloam, Thoeny, Kevin, and Scobey soils are included with this soil in mapping. The Elloam soil is nearly level; it is in small depressions and is moderately affected by sodium. The Thoeny soil is in vegetated depressions.

The Phillips soil is used for dryland crops, mainly wheat, barley, and oats. Small areas are irrigated for wheat, barley, and alfalfa. Wind erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and stubble mulch tillage can effectively control wind erosion.

This soil is suited to use as rangeland and is used mainly as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of threadleaf sedge, prairie junegrass, needleandthread, blue grama, and fringed sagewort. Weedy plants likely to invade with continued grazing pressure are annual grasses, plains pricklypear, broom snakeweed, and clubmoss. Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokeberry, American plum, skunkbush sumac, and silver buffaloberry.

The slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 10- to 14-inch precipitation zone.

96—Phillips loam, 4 to 8 percent slopes. This is a deep, well drained, moderately sloping soil that formed in glacial till on uplands. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is brown loam 2 inches thick. The subsurface layer is pale brown and light brownish gray loam 5 inches thick. The subsoil is brown clay and grayish brown clay loam 15 inches thick. The substratum is grayish brown clay loam to a depth of 78 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

Small areas of Elloam, Thoeny, and Kevin soils are included with this soil in mapping. The Elloam soil is in small, sparsely vegetated depressions. It is moderately affected by sodium. The Thoeny soil is in vegetated depressions.

The Phillips soil is used mainly as rangeland. In some areas it is used for dryland crops, mainly wheat, barley, and oats. Wind and water erosion are the main limitations to use of this soil for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, prairie junegrass, blue grama, threadleaf sedge, and fringed sagewort increase. Weedy plants likely to invade are annual grasses, plains pricklypear, snakeweed, and clubmoss. Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian

peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry.

The slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

97—Phillips-Elloam complex, 0 to 4 percent slopes. This complex consists of nearly level to undulating Phillips and Elloam soils on glaciated uplands (fig. 5). The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Phillips soil makes up about 60 percent of the map unit, and the Elloam soil makes up 20 percent. Included with these soils in mapping are small areas of Assinniboine, Kevin, Telstad, and Thoeny soils. These soils make up about 20 percent of the map unit. The Thoeny soil is in vegetated depressions.

The Phillips soil is deep and well drained. It formed in glacial till in smooth areas on uplands. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is pale brown and light brownish gray loam 5 inches thick. The subsoil is brown clay and grayish brown clay loam 15 inches thick. The substratum is grayish brown clay loam to a depth of 78 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Elloam soil is deep and well drained. It formed in glacial till, and it is in small, sparsely vegetated

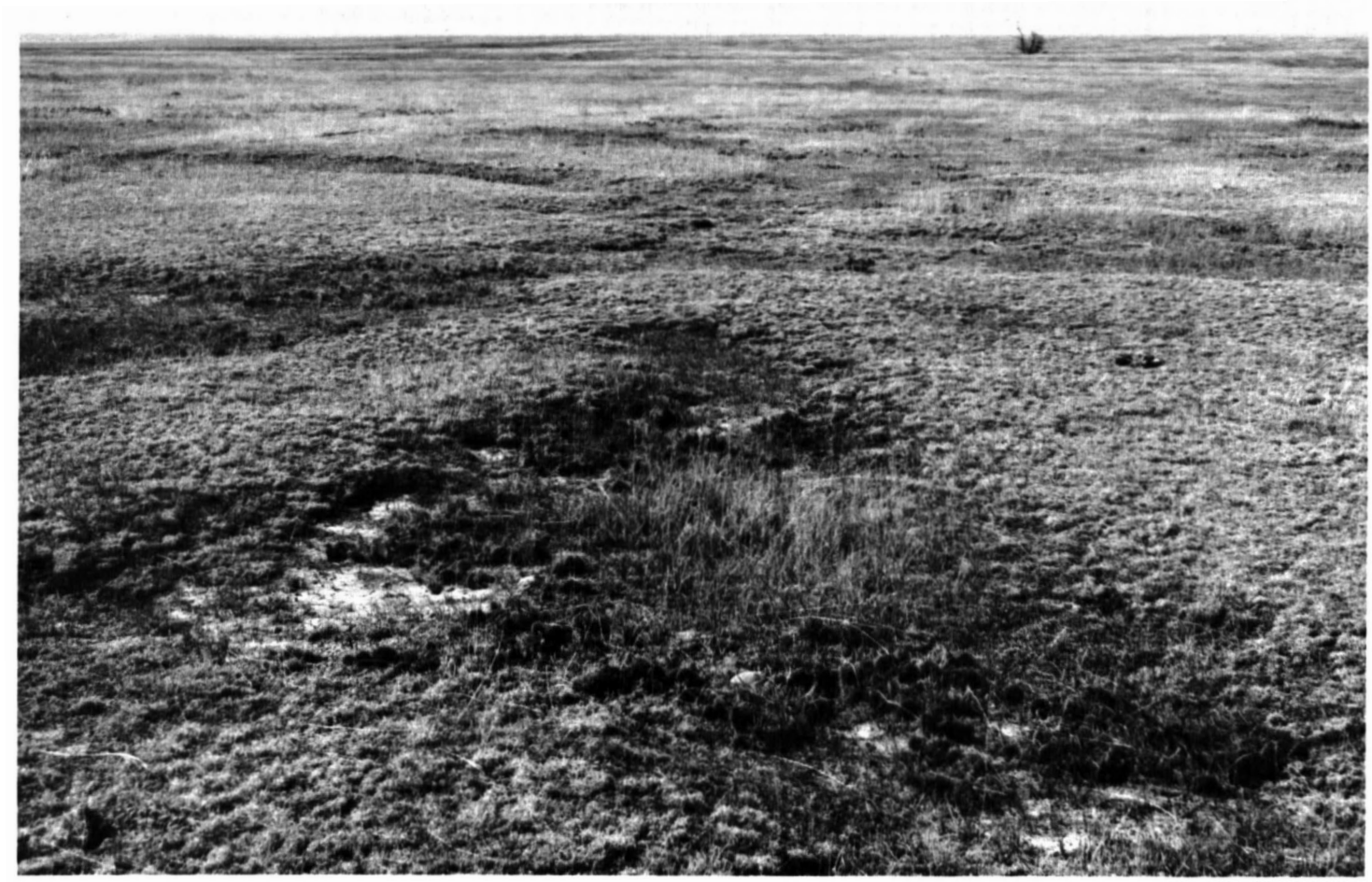


Figure 5.—Area of Phillips-Elloam complex, 0 to 4 percent slopes, in native rangeland that has a heavy infestation of clubmoss. The Elloam soil is in the sparsely vegetated concave depressions, and the Phillips soil is in the raised, more densely vegetated areas.

depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is light brownish gray clay loam. The subsoil is grayish brown clay loam to a depth of 60 inches.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops, mainly wheat and barley.

Wind erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue are effective in controlling wind erosion.

The soils in this complex are well suited to use as rangeland. Most of the forage is produced on the Phillips soil. The potential plant community on the Phillips soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. The potential plant community on the Elloam soil consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needlegrass, and Nuttall saltbush and an increase of plants such as needleandthread, blue grama, fringed sagewort, and prairie junegrass. Weedy plants likely to invade are annual grasses, clubmoss, broom snakeweed, plains pricklypear, foxtail barley, and curlycup gumweed.

On the Phillips soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Elloam soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils can be used for windbreaks. On the Phillips soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. The subsoil of the Elloam soil is moderately affected by sodium; thus, the choice of shrubs and trees is restricted. On the Elloam soil, suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability of the Phillips soil and the very slow permeability of the Elloam soil limit these soils for most urban uses. Septic tank absorption fields require special design because of the slow or very slow permeability.

Capability subclass IIIe, dryland. Phillips soil is in Silty range site, 10- to 14-inch precipitation zone; Elloam soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

98—Phillips-Elloam complex, 4 to 8 percent slopes. This complex consists of gently rolling Phillips and Elloam soils on glaciated uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Phillips soil makes up about 60 percent of this map unit, and the Elloam soil makes up 20 percent. Included with these soils in mapping are small areas of Hillon, Thoeny, Kevin, Telstad, and Chinook soils. These soils make up about 20 percent of the map unit. The Thoeny soil is in vegetated depressions.

The Phillips soil is deep and well drained. It formed in glacial till in smooth areas on uplands. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is pale brown and light brownish gray loam 5 inches thick. The subsoil is brown clay and brown clay loam 15 inches thick. The substratum is grayish brown clay loam to a depth of 78 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Elloam soil is deep and well drained. It formed in glacial till in small, sparsely vegetated depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is light brownish gray clay loam. The subsoil is grayish brown clay loam 10 inches thick. The substratum is mostly grayish brown clay loam to a depth of 60 inches.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The soils in this complex are used mainly as rangeland. In some areas they are used for dryland crops, mainly wheat, oats, and barley.

Wind and water erosion are the main limitations to use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion. Because the subsoil of the Elloam soil is moderately affected by sodium and the surface is subject to crusting, seedling emergence is impeded and crop yields are reduced.

The soils in this complex are suited to use as rangeland. Most forage for grazing is produced on the Phillips soil. The potential plant community on the Phillips soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. The potential plant community on the Elloam soil consists mainly of western wheatgrass, green needlegrass, alkaligrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needlegrass, and Nuttall saltbush and an increase of needleandthread, blue grama, fringed sagewort, and prairie junegrass. Weedy plants likely to invade are annual grasses, broom snakeweed, plains pricklypear, and clubmoss.

On the Phillips soil, forage production is 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Elloam soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils in this complex can be used for windbreaks. On the Phillips soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. The subsoil of the Elloam soil is moderately affected by sodium; thus the choice of shrubs and trees is restricted. On the Elloam soil, suitable trees include Russian-olive and Siberian elm. Suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability of the Phillips soil and the very slow permeability of the Elloam soil limit these soils for most urban uses. Septic tank absorption fields require special design because of the slow and very slow permeability.

Capability subclass IIIe, dryland. Phillips soil is in Silty range site, 10- to 14-inch precipitation zone; Elloam soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

99—Phillips-Kevin complex, 0 to 4 percent slopes. This complex consists of nearly level to undulating Phillips soil and undulating Kevin soil on glaciated uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Phillips soil makes up about 50 percent of the map unit, and the Kevin soil makes up about 30 percent. Included with these soils in mapping are small areas of Elloam, Thoeny, Scobey, and Hillon soils. These soils make up about 20 percent of this map unit. The Elloam soil is in small, sparsely vegetated depressions. It is moderately affected by sodium.

The Phillips soil is deep and well drained. It formed in glacial till on uplands. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is pale brown and light brownish gray loam 5 inches thick. The subsoil is brown clay and grayish brown clay loam 15 inches thick. The substratum is grayish brown clay loam to a depth of 78 inches.

Permeability is slow, and the available water capacity is high. The effective wetting depth of the soil under native vegetation is about 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Kevin soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

In some areas the soils in this complex are used for dryland crops, mainly wheat, barley, and oats. Wind erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

The soils in this complex are well suited to use as rangeland and are used mainly as rangeland. The potential plant community on these soils consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of such plants as needleandthread, threadleaf sedge, prairie junegrass, blue grama, and fringed sagewort. Weedy plants likely to invade are annual grasses, broom snakeweed, and clubmoss. Forage production is 1,500 pounds per acre in favorable years, and 800 pounds per acre in unfavorable years for both the Phillips and Kevin soils.

Clubmoss is very competitive, and the possibility of heavy infestation by clubmoss is a very serious problem. Clubmoss forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. On the Phillips soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. On the Kevin soil, suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

100—Phillips-Kevin complex, 4 to 8 percent slopes. This complex consists of gently rolling Phillips and Kevin soils on glaciated uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Phillips soil makes up about 40 percent of this map unit, and the Kevin soil makes up 40 percent. Included with these soils in mapping are small areas of Elloam, Thoeny, Scobey, and Hillon soils. These soils make up about 20 percent of the map unit. The Elloam soil is in small, sparsely vegetated depressions. It is moderately affected by sodium. The Thoeny soil is in vegetated depressions.

The Phillips soil is deep and well drained. It formed in glacial till on uplands. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is pale brown and light brownish gray loam 5 inches thick. The subsoil is brown clay and grayish brown clay loam 15 inches thick. The substratum is grayish brown clay loam to a depth of 78 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Kevin soil is deep and well drained. It formed in glacial till on the upper slopes of knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

In some areas the soils in this complex are used for dryland crops, mainly wheat, barley, and oats. Wind and water erosion are the main limitations to use of these soils for cultivated crops.

Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

These soils are suited to use as rangeland and are used mainly as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of plants such as threadleaf sedge, prairie junegrass, needleandthread, blue grama, fringed sagewort, annual grasses, broom snakeweed, and clubmoss.

Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years for both the Phillips and Kevin soils.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. On the Phillips soil, suitable trees include Russian-olive, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, skunkbush sumac, and silver buffaloberry. On the Kevin soil, suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

101—Pits, gravel. This map unit consists of gravel pits on uplands. The areas are larger than 40 acres and have been stripped in mining gravel and sand. They are mostly on a large glacial outwash moraine south of Chinook. The elevation is 2,400 to 2,800 feet. Slopes range from 2 to 15 percent. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days. Runoff is slow.

Included in mapping are small areas of sand and gravel piles, mounds of overburden, and Wabek soils.

In some areas the gravel pits are nearly barren. They are mainly suited to use as a watershed and for wildlife habitat.

Capability class VIII, dryland.

102—Reeder loam, 2 to 4 percent slopes. This is a moderately deep, well drained soil on uplands. It formed in material that weathered from soft sedimentary beds. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark brown loam 7 inches thick. The subsoil is mostly dark brown clay loam 13 inches thick. The substratum is light brownish gray clay loam 8 inches thick. Soft sedimentary beds to a depth of 45 inches are light olive gray, soft siltstone that rubs to loam or silt loam. Below that, to a depth of 60 inches, the beds are light brownish gray, soft sandstone that rubs to loamy fine sand or fine sandy loam.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The depth to soft sedimentary beds ranges from 20 to 40 inches.

Included with this soil in mapping are a few small areas of Elloam, Cabba, Williams, and Vida soils and soils that formed in a thin layer of glacial till over the sedimentary beds. The Elloam soil is in small, sparsely vegetated depressions. It is moderately affected by sodium. The undulating Cabba soil is on knolls and ridges and is shallow.

The Reeder soil is used for dryland crops and as rangeland. The main dryland crops are wheat, oats, and barley. Wind erosion is a limitation to the use of this soil as cropland. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, basin wildrye, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Its moderate available water capacity restricts the choice of shrubs and trees to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The soft sedimentary beds at a depth of 20 to 40 inches limit this soil for most urban uses. Septic tank absorption fields require special design because of the soft sedimentary beds.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

103—Reeder loam, 4 to 8 percent slopes. This is a moderately deep, well drained, gently rolling soil on uplands. It formed in material that weathered from soft sedimentary beds. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark brown loam 7 inches thick. The subsoil is mostly dark brown clay loam 13 inches thick. The substratum is light brownish gray clay loam 8 inches thick. Soft sedimentary beds to a depth of 45 inches are light olive gray, soft siltstone that rubs to loam or silt loam. Below that, to a depth of 60 inches, the beds are light brownish gray sandstone that rubs to loamy fine sand or fine sandy loam.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is about 28 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is medium. Water and wind erosion are moderate hazards. The depth to soft sedimentary beds ranges from 20 to 40 inches.

Included with this soil in mapping are a few small areas of Elloam, Cabba, Williams, and Vida soils and soils that formed in a thin mantle of glacial till over the sedimentary beds. The Elloam soil is in small, sparsely vegetated depressions. It is moderately affected by sodium. The undulating Cabba soil is on knolls and ridges. It is a shallow soil.

The Reeder soil is used for dryland crops and as rangeland. The main crops are wheat, oats, and barley. Wind erosion is a limitation to the use of this soil as cropland. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists of rough fescue, bluebunch

wheatgrass, green needlegrass, basin wildrye, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. The moderate available water capacity restricts the choice of shrubs and trees to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The moderate depth to soft sedimentary beds limits this soil for most urban uses. Septic tank absorption fields require special design because of the sedimentary beds.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

104—Rubble land-Rock outcrop association. This association consists of very steep Rubble land and Rock outcrop on the side of mountains. Rubble land consists of large boulders and stones that have collected along the sides and at the base of ridges below areas of exposed bedrock. Rock outcrop is along the crest of ridges. There are taluses below the Rock outcrop. The elevation is 3,000 to 6,000 feet.

Rubble land makes up about 65 percent of this association, and Rock outcrop makes up 25 percent. Included in mapping are small areas of steep Castner and Belain soils. These soils make up about 10 percent of the association.

This association is suited to and is used for wildlife habitat, watershed, and recreation.

Capability class VIII, dryland.

105—Savage silty clay loam, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil that formed in alluvium on stream terraces and fans. The elevation is 2,500 to 4,000 feet. Slopes are mainly short. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark grayish brown silty clay loam 6 inches thick. The subsoil is dark grayish brown silty clay and grayish brown silty clay loam 15 inches thick. The substratum, to a depth of 60 inches, is grayish brown silty clay loam.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are a few small areas of Gerdrum, Farnuf, and Straw soils. The Gerdrum soil is nearly level; it is in small, sparsely vegetated depressions. It is moderately affected by sodium.

The Savage soil is used for dryland and irrigated crops and as rangeland. The main dryland crops are wheat, barley, and oats, and the main irrigated crops are alfalfa, wheat, barley, and corn. Wind erosion is the main limitation to the use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease and Idaho fescue, prairie junegrass, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and big sagebrush increase. Weedy plants likely to invade are Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. Forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a very serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, allows desirable native plants to become reestablished, and thus increases forage production.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderately slow permeability, high shrink-swell potential, and low soil strength limit this soil for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability.

Foundations and basements for houses require special design because of the high shrink-swell potential and low soil strength.

Capability subclass IIIe, dryland, and IIc, irrigated; Silty range site, 15- to 19-inch precipitation zone.

106—Savage silty clay loam, 2 to 4 percent slopes. This is a deep, well drained, undulating soil that formed in alluvium on stream terraces and fans. The elevation is 2,500 to 4,000 feet. Slopes are mainly short. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark grayish brown silty clay loam 6 inches thick. The subsoil is dark grayish brown silty clay and grayish brown silty clay loam 15 inches thick. The substratum, to a depth of 60 inches, is grayish brown silty clay loam.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are a few small areas of Gerdrum, Farnuf, and Straw soils. The gently sloping Gerdrum soil is in small, sparsely vegetated depressions. It is moderately affected by sodium.

The Savage soil is used for dryland and irrigated crops and as rangeland. The main dryland crops are wheat, barley, and oats, and the main irrigated crops are alfalfa, wheat, barley, and corn. Wind erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye and an increase of plants such as Idaho fescue, needleandthread, prairie junegrass, western wheatgrass, fringed sagewort, common snowberry, big sagebrush, Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. Forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a very serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, allows desirable native plants to become reestablished, and thus increases forage production.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderately slow permeability, high shrink-swell potential, and low strength limit this soil for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability. Foundations and basements for houses require special design because of the high shrink-swell potential and low soil strength.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

107—Savage-Gerdrum silty clay loams, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping soils on stream terraces and fans on uplands. The elevation is 2,500 to 4,000 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Savage soil makes up about 65 percent of the map unit, and the Gerdrum soil makes up 20 percent. Included with these soils in mapping are small areas of Farnuf, Korent, and Straw soils. These soils make up about 15 percent of the map unit.

The Savage soil is deep and well drained. It formed in alluvium, and it is in smooth areas. Typically, the surface layer is dark grayish brown silty clay loam 6 inches thick. The subsoil is dark grayish brown silty clay and grayish brown silty clay loam 15 inches thick. The substratum, to a depth of 60 inches or more, is grayish brown silty clay loam.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Gerdrum soil is deep and well drained. It formed in alluvium in small, sparsely vegetated depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The upper part of the subsoil is mostly grayish brown clay 15 inches thick. The lower part is light brownish gray clay loam to a depth of 60 inches or more. The upper part of the substratum is grayish brown sandy clay loam 10 inches thick. The lower part is brown gravelly sandy loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is

a slight hazard. The subsoil is moderately affected by sodium. When dry, the subsoil is very hard, and it impedes the penetration of roots and moisture. If this soil is used for cultivated crops, the surface layer and upper part of the subsoil are mixed. This causes the surface to crust. The crust impedes seedling emergence, and thus crop yields are reduced.

In some areas the soils in this complex are used for dryland crops, mainly wheat, barley, and oats. Wind erosion on both soils and surface crusting on the Gerdrum soil are the main limitations to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. On the Gerdrum soil, applications of manure or other organic matter reduce surface crusting and increase crop yields.

These soils are suited to use as rangeland and are used mainly as rangeland. Most of the forage is produced on the Savage soil. The potential plant community on the Savage soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. The potential plant community on the Gerdrum soil consists of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, Nuttall saltbush, green needlegrass, and basin wildrye and an increase of needleandthread, prairie junegrass, inland saltgrass, fringed sagewort, shrubby cinquefoil, Kentucky bluegrass, foxtail barley, greasewood, pussytoes, plains pricklypear, and clubmoss.

On the Savage soil, the potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years. On the Gerdrum soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a very serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, allows desirable native plants to become reestablished, and thus increases forage production.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. On the Savage soil, suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac. Because the Gerdrum soil is moderately affected by sodium, the choice of shrubs and trees is restricted to those that are sodium resistant. On the Gerdrum soil, suitable trees include Russian-olive and Siberian elm, and suitable shrubs are Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The high shrink-swell potential, low soil strength, and moderately slow permeability of the Savage soil limit the soils in this complex for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability of the Savage soil, and foundations and basements for houses require special design because of the high shrink-swell potential and low soil strength.

Capability subclass IIIs, dryland. Savage soil is in Silty range site, 15- to 19-inch precipitation zone; Gerdrum soil is in Dense Clay range site, 15- to 19-inch precipitation zone.

108—Scobey clay loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to undulating soil that formed in glacial till on uplands. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer is grayish brown clay loam 6 inches thick. The upper part of the subsoil is brown clay 6 inches thick, and the lower part is grayish brown clay loam 7 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Elloam, Kevin, and Phillips soils are included with this soil in mapping. The nearly level Elloam soil is in depressions. It is moderately affected by sodium.

This Scobey soil is used for dryland and irrigated crops. It is also used as rangeland. The main dryland crops are wheat, barley, and oats; the main irrigated crops are wheat, barley, and alfalfa. Wind erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease; needleandthread, blue grama, and fringed sagewort increase; and annual grasses, broom snakeweed, and clubmoss are likely to invade. The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The low soil strength and slow permeability limit this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability. Basements and foundations need special design because of the low soil strength.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 10- to 14-inch precipitation zone.

109—Scobey-Kevin clay loams, 0 to 4 percent slopes. This complex consists of nearly level to undulating soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Scobey soil makes up about 55 percent of this map unit, and the Kevin soil makes up 35 percent. Included with these soils in mapping are small areas of Dimmick, Nishon, Elloam, Hillon, and Phillips soils. These soils make up about 10 percent of the map unit. Dimmick and Nishon soils are nearly level. They are in small enclosed basins that are subject to ponding. The Elloam soil is in small, sparsely vegetated depressions and is moderately affected by sodium. The Hillon soil is on knolls.

The Scobey soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is grayish brown clay loam 6 inches thick. The upper part of the subsoil is brown clay 6 inches thick, and the lower part is grayish brown clay loam 7 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Kevin soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The soils in this complex are used for dryland crops and as rangeland. The main dryland crops are wheat and barley. Wind erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

These soils are suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of needleandthread, prairie junegrass, blue grama, and fringed sagewort. Weedy plants likely to invade are annual grasses, broom snakeweed, and clubmoss. Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years for both the Scobey and Kevin soils.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

110—Scobey-Kevin clay loams, 4 to 8 percent slopes. This complex consists of gently rolling soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Scobey soil makes up about 45 percent of this map unit, and the Kevin soil makes up 40 percent. Included with these soils in mapping are small areas of Dimmick, Nishon, Elloam, Hillon, and Phillips soils. These

soils make up about 15 percent of the map unit. Dimmick and Nishon soils are nearly level; they are in basins and are subject to ponding. The Elloam soil is nearly level; it is in small, sparsely vegetated depressions and is moderately affected by sodium. The Hillon soil is on knolls.

The Scobey soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is grayish brown clay loam 6 inches thick. The upper part of the subsoil is brown clay 6 inches thick. The lower part is grayish brown clay loam 7 inches thick. The substratum is light brownish gray and grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Kevin soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

These soils are used for dryland crops and as rangeland. The main crops are wheat and barley. Wind erosion and water erosion are the main limitations to use of these soils for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

These soils are suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of needleandthread, threadleaf sedge, prairie junegrass, blue grama, fringed sagewort, annual grasses, broom snakeweed, and clubmoss. Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years for both the Scobey and Kevin soils.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

111—Shaak loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil on uplands. It formed in alluvium on terraces and fans. The elevation is 3,000 to 4,200 feet. Slopes are mainly long. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer, where it is mixed to a depth of about 6 inches, is mainly grayish brown loam. The subsoil is 22 inches thick. The upper part is brown clay, and the lower part is mainly grayish brown clay loam. The upper part of the substratum is brown gravelly sandy clay loam 14 inches thick, and the lower part is brown very gravelly sandy loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Gerdrum and Work soils are included with this soil in mapping. The nearly level Gerdrum soil is in small, sparsely vegetated depressions. It is moderately affected by sodium.

The Shaak soil is used mainly for dryland crops and as rangeland. The main crops are wheat, barley, and oats. Wind erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, and ponderosa pine. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, and green needlegrass decrease; Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil increase; and Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss invade. The potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a

spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

112—Shaak-Gerdrum complex, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping soils on terraces and fans on uplands. The elevation is 3,000 to 4,200 feet. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Shaak soil makes up about 65 percent of this map unit, and the Gerdrum soil makes up 25 percent. Included with these soils in mapping are small areas of Work soil. This soil makes up about 10 percent of the map unit.

The Shaak soil is deep and well drained. It formed in alluvium in smooth areas throughout the survey area. Typically, the surface layer, where it is mixed to a depth of about 6 inches, is mostly grayish brown loam. The subsoil is 22 inches thick. The upper part is brown clay, and the lower part is grayish brown clay loam. The upper part of the substratum is brown gravelly sandy clay loam 14 inches thick. The lower part is brown, very gravelly sandy loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Gerdrum soil is deep and well drained. It formed in alluvium in small, sparsely vegetated depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The upper part of the subsoil is mostly grayish brown clay 15 inches thick. The lower part is light brownish gray clay loam 14 inches thick. The upper part of the substratum is grayish brown sandy clay loam 10 inches thick. The lower part is brown gravelly sandy loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil, which is moderately affected by sodium, is very hard when dry and thus impedes the penetration of roots and moisture. If this soil is cultivated, the surface layer and upper part of the subsoil are mixed. This causes the surface to crust. The crust impedes seedling emergence, and thus crop yields are reduced.

In some areas, the soils in this complex are used for dryland crops, mainly wheat, oats, and barley. Wind erosion on both soils and surface crusting on the Gerdrum soil are the main limitations to use of these soils for cultivated crops.

Stripcropping, tall grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion. Applications of manure or other organic matter reduce surface crusting and increase crop yields.

The soils in this complex are suited to use as rangeland and are used mainly as rangeland. Most of the forage is produced on the Shaak soil. The potential plant community on the Shaak soil consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. The potential plant community on the Gerdrum soil consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Sandberg bluegrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, Nuttall saltbush, and green needlegrass and an increase of Idaho fescue, big sagebrush, needleandthread, blue grama, prairie junegrass, inland saltgrass, fringed sagewort, and shrubby cinquefoil. Weedy plants likely to invade are Kentucky bluegrass, foxtail barley, greasewood, pussytoes, plains pricklypear, and clubmoss.

On the Shaak soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Gerdrum soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. Because the Gerdrum soil is moderately affected by sodium, the choice of shrubs and trees is restricted to those that are

resistant to sodium. On the Shaak soil, suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac. On the Gerdrum soil, suitable trees include Russian-olive and Siberian elm, and suitable shrubs are Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The slow permeability of both soils and the high shrink-swell potential and low soil strength of the Gerdrum soil limit the soils in this complex for most urban uses. Septic tank absorption fields, for example, require special design because of these limitations. Basements and foundations for buildings on the Gerdrum soil need special design because of the high shrink-swell potential and the low soil strength.

Capability subclass IVs, dryland. Shaak soil is in Silty range site, 10- to 14-inch precipitation zone; Gerdrum soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

113—Shawmut gravelly loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil on uplands. It formed in alluvium on terraces and fans. The elevation is 2,800 to 4,000 feet. Slopes are mainly medium in length. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is dark brown gravelly loam 3 inches thick. The subsoil is mostly dark grayish brown gravelly clay loam and grayish brown very gravelly clay loam 12 inches thick. The substratum, to a depth of 60 inches is grayish brown very gravelly loam and extremely gravelly loam.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Farnuf, Turner, and Work soils are included with this soil in mapping.

This Shawmut soil is used for dryland and irrigated crops. It is also used as rangeland. The main dryland crops are wheat, barley, and oats. The main irrigated crop is alfalfa.

Droughtiness and wind erosion are the main limitations to use of this soil for cultivated crops. Because of droughtiness, successful crop production depends on proper distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall-grass barriers for trapping windblown snow help to conserve moisture. Stripcropping, tall-grass barriers, minimum tillage, and stubble mulch tillage help to control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, basin wildrye, and ponderosa pine. Some sedges, forbs, and woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; Idaho fescue, needleandthread, western wheatgrass, prairie junegrass, fringed sagewort, common snowberry, and big sagebrush increase; and Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes invade. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Because of its low available water capacity the choice of shrubs and trees is restricted to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses.

Capability subclass IIIs, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

114—Shawmut gravelly loam, 4 to 8 percent slopes. This is a deep, well drained, moderately sloping soil on uplands. It formed in alluvium on terraces and fans. The elevation is 2,800 to 4,000 feet. Slopes are mainly medium in length. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark brown gravelly loam 3 inches thick. The subsoil is mostly dark grayish brown gravelly clay loam and grayish brown very gravelly clay loam 12 inches thick. The substratum to a depth of 60 inches is grayish brown very gravelly loam and extremely gravelly loam.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is medium. Wind and water erosion are moderate hazards.

Small areas of Farnuf, Turner, and Work soils are included with this soil in mapping.

This soil is used mainly for dryland and irrigated crops. It is also used as rangeland. The main dryland crops are wheat, barley, and oats. The main irrigated crop is alfalfa.

Droughtiness and wind and water erosion are the main limitations to use of this soil for cultivated crops. Because of the droughtiness, successful crop production depends on a suitable distribution of rainfall during the growing season. Stubble mulch tillage, minimum tillage, and tall-grass barriers for trapping windblown snow help to conserve moisture. Stripcropping, tall-grass barriers,

minimum tillage, and stubble mulch tillage help to control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, basin wildrye, and ponderosa pine. Sedges, forbs, and some woody plants are decreasers. If the rangeland is overgrazed, rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye decrease; Idaho fescue, needleandthread, western wheatgrass, prairie junegrass, fringed sagewort, common snowberry, and big sagebrush increase; and Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes invade. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Because of the low available water capacity, the choice of shrubs and trees is restricted to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry.

This soil is suited to most urban uses.

Capability subclass IVs, dryland, and IVs, irrigated; Silty range site, 15- to 19-inch precipitation zone.

115—Silverchief-Whitecow-Macmeal association, steep. This association consists of Silverchief soil, Whitecow soil on south-facing slopes, and Macmeal soil on north-facing slopes. The elevation is 4,000 to 6,000 feet. The average annual precipitation is 19 inches, and the average annual temperature is 40 degrees F. The average growing season is 90 days.

The Silverchief soil makes up about 35 percent of the map unit, the Whitecow soil makes up 30 percent, and the Macmeal soil makes up 25 percent. Included with these soils in mapping are small areas of Warneke soil and other deep loamy soils. These soils make up about 10 percent of the map unit.

The Silverchief soil is deep and well drained. It formed in colluvium or alluvium of igneous and sedimentary rocks on the lower part of mountain slopes and on fans. Typically, the surface layer is covered by an organic mat 3 inches thick. The surface layer is pale brown loam 5 inches thick. The subsoil is light olive brown clay and gravelly clay 22 inches thick. The substratum is brown, very gravelly sandy clay loam to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 48 inches. Runoff is medium. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Whitecow soil is deep and well drained. It formed in colluvium or alluvium of limestone on south- and west-facing slopes on mountainsides. Typically, the surface layer is covered by an organic mat 1 inch thick. The upper part of the surface layer is dark grayish brown gravelly loam 3 inches thick, and the lower part is grayish brown very gravelly loam 7 inches thick. The subsoil is light brownish gray very gravelly loam 10 inches thick. The substratum is light brownish gray extremely gravelly loam to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Macmeal soil is deep and well drained. It formed in material that weathered from igneous and metamorphic rock on north- and east-facing slopes on mountainsides. Typically, the surface layer is covered by an organic mat 2 inches thick. The surface layer is pale brown gravelly loam 7 inches thick. The upper part of the subsoil is yellowish brown very gravelly clay loam 7 inches thick. The middle part is yellowish brown, extremely channery clay loam 34 inches thick. The lower part is brown, extremely flaggy clay loam to a depth of 60 inches.

Permeability is moderately slow, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

In 1936, a forest fire burned most of the trees in the Little Rocky Mountains. A few scattered stands of Douglas-fir, lodgepole pine, and ponderosa pine survived and provided a source of seed for the regeneration of trees. Grasses and shrubs cover most of the area and protect the soils from erosion. Because grasses and shrubs are strong competitors for moisture and nutrients, they have delayed the reestablishment of trees in most parts of the Little Rocky Mountains.

The soils in this association are suited to use as rangeland. Most of the forage is produced on the soils on north- and east-facing slopes.

The potential plant community on the soils on north- and east-facing slopes consists mainly of rough fescue, green needlegrass, bluebunch wheatgrass, Saskatoon serviceberry, Idaho fescue, Oregongrape, and common snowberry. The potential plant community on the soils on south- and west-facing slopes consists mainly of rough fescue, little bluestem, green needlegrass, bluebunch wheatgrass, western wheatgrass, prairie junegrass, and needleandthread. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, green needlegrass, and little bluestem and an increase of plants such as Idaho fescue, common snowberry, prairie junegrass,

needleandthread, Kentucky bluegrass, Canada thistle, timothy, annual grasses, and forbs.

The soils in this association are suited to woodland use. The Silverchief and Macmeal soils, on north- and east-facing slopes, are suited to Douglas-fir and lodgepole pine. The Silverchief soil is capable of producing about 5,020 cubic feet, or 15,080 board feet (Scribner rule), per acre of Douglas-fir and 7,860 cubic feet, or 22,000 board feet (Scribner rule), per acre of lodgepole pine. The Macmeal soil is capable of producing about 4,495 cubic feet, or 11,510 board feet (Scribner rule), per acre of Douglas-fir and 6,500 cubic feet, or 17,000 board feet (Scribner rule), per acre of lodgepole pine. The Whitecow soil, on south- and west-facing slopes, is suited to ponderosa pine. This soil is capable of producing about 3,900 cubic feet, or 7,800 board feet (Scribner rule), per acre of ponderosa pine. These production levels are from fully stocked, even-aged, unmanaged stands of 100-year-old trees.

There are limitations to the use of these soils for timber production. The Silverchief soil, for example, is strongly sloping to steep and has clay in the subsoil. The Whitecow and Macmeal soils are steep and very steep and have a low available water capacity. The clay in the subsoil of the Silverchief soil restricts the use of logging equipment in wet seasons. Because the Whitecow and Macmeal soils are on hot, dry, south-facing slopes and have a low available water capacity, regeneration of trees is limited and seedling mortality is high. To reduce plant competition and seedling mortality, site scarification during harvest and regeneration work are necessary in areas of all three soils. To prevent excessive erosion, logs should not be skidded in drainageways, and to prevent deeply rutted paths from forming, numerous trails should be used in skidding logs.

The soils in this association are not suitable for windbreaks because slopes are greater than 15 percent.

Steep slopes limit these soils for most urban uses. The moderately slow permeability of the Silverchief and Macmeal soils is an additional limitation. Septic tank absorption fields require special design because of the moderately slow permeability.

Silverchief soil is in capability subclass VIe, dryland; Whitecow and Macmeal soils are in capability subclass VIIe, dryland.

116—Straw-Korent loams. This complex consists of nearly level soils on flood plains and stream terraces. The elevation is 2,600 to 4,000 feet. Slopes are 0 to 2 percent. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Straw soil makes up about 45 percent of this map unit, and the Korent soils makes up 40 percent. Included with these soils in mapping are small areas of Farnuf and Nesda soils. These soils make up about 15 percent of the map unit. The nearly level Nesda soil is on the edge of stream terraces.

The Straw soil is deep and well drained. It formed in alluvium in areas not identified by unique landscape features. Typically, the upper part of the surface layer is dark grayish brown loam 7 inches thick, and the lower part is dark grayish brown silt loam 14 inches thick. There are thin strata of fine sandy loam in the lower part. The substratum to a depth of 60 inches is grayish brown loam stratified with sandy loam and silty clay loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is subject to rare flooding.

The Korent soil is deep and well drained. It formed in alluvium in areas not identified by unique landscape features. Typically, the surface layer is dark grayish brown loam 7 inches thick. The upper part of the substratum is brown silt loam 7 inches thick. Below that, the substratum is grayish brown sandy clay loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is subject to rare flooding.

The soils in this complex are used for dryland and irrigated crops. They are also used as rangeland. The main dryland crops are wheat, barley, and oats, and the main irrigated crops are wheat, barley, alfalfa, and corn. Wind erosion is the main limitation to the use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage and tillage that utilizes crop residue can effectively control wind erosion.

These soils are suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of such plants as Idaho fescue, needleandthread, prairie junegrass, western wheatgrass, fringed sagewort, common snowberry, big sagebrush, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. Forage production on the Straw and Korent soils is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The main limitation to the use of these soils for urban development is the fact that they may be flooded.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

117—Straw-Korent loams, occasionally flooded. This complex consists of nearly level soils on low stream terraces and flood plains. The elevation is 2,600 to 4,000 feet. Slopes are 0 to 2 percent. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Straw soil makes up about 40 percent of this map unit, and the Korent soil makes up 40 percent. Included with these soils in mapping are small areas of Nesda soil and other moderately well drained or somewhat poorly drained loam and clay loam soils. These soils make up about 20 percent of the map unit. The nearly level Nesda soil is on the edge of terraces. The moderately well drained or somewhat poorly drained loam and clay loam soils are in lower areas adjacent to stream channels.

The Straw soil is deep and well drained. It formed in alluvium in areas not identified by unique landscape features. Typically, the upper part of the surface layer is dark grayish brown loam 7 inches thick, and the lower part is dark grayish brown silt loam 14 inches thick. There are thin strata of fine sandy loam in the lower part. The substratum to a depth of 60 inches or more is grayish brown loam; it has thin strata of sandy loam and silty clay loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind and water erosion are moderate hazards. This soil is subject to occasional flooding in spring.

The Korent soil is deep and well drained. It formed in alluvium in areas not identified by unique landscape features. Typically, the surface layer is dark grayish brown loam 7 inches thick. The upper part of the substratum is brown silt loam 7 inches thick, and the lower part is grayish brown sandy clay loam to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind and water erosion are moderate hazards. This soil is subject to occasional flooding in spring.

The soils in this complex are used mainly for irrigated alfalfa and as rangeland. Occasional flooding is the main limitation to the use of these soils for cultivated crops.

These soils are suited to use as rangeland. The potential plant community consists mainly of basin wildrye, prairie cordgrass, tall sedges, and tufted hairgrass. Forbs and some woody plants are decreasers. If the rangeland is overgrazed, basin wildrye, prairie cordgrass, and tufted hairgrass decrease and western wheatgrass, Baltic rush, and shrubby cinquefoil increase. Weedy plants that are likely to invade are foxtail barley and Kentucky bluegrass. The potential plant community on the Straw and Korent soils produces 2,000 pounds of forage per acre in favorable years and 1,200 pounds per acre in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and cottonwood. Suitable shrubs include common chokecherry, American plum, silver buffaloberry, lilac, skunkbush sumac, and sandcherry.

Occasional flooding imposes serious limitations to the use of these soils for urban development.

Capability subclass IIIw, dryland, and IIIw, irrigated; Overflow range site, 15- to 19-inch precipitation zone.

118—Straw and Nesda soils, channeled. This map unit consists of nearly level, deep, well drained soils on bottom lands and low stream terraces. The elevation is 2,600 to 4,000 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 115 days.

Included with these soils in mapping are small areas of Korent soils, some wet or wet and saline soils, and some very gravelly soils. These soils are subject to occasional flooding and to streambank erosion.

Typically, in the Straw soil, the upper part of the surface layer is dark grayish brown loam 7 inches thick, and the lower part is dark grayish brown silt loam 14 inches thick. There are thin strata of fine sandy loam in the lower part. The substratum to a depth of 60 inches is grayish brown loam; it has thin strata of sandy loam and silty clay loam.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard except where there is channeling and streambank erosion. The soil is subject to occasional flooding during spring.

Typically, in the Nesda soil, the upper part of the surface layer is grayish brown loam 7 inches thick, and the lower part is brown sandy loam 4 inches thick. The upper part of the substratum is grayish brown, very gravelly loamy sand 4 inches thick, and the lower part is very gravelly sand to a depth of 60 inches or more.

Permeability is moderate to a depth of about 11 inches and very rapid below a depth of 11 inches. The available water capacity is low or very low. The effective rooting depth is about 60 inches. The average annual wetting depth under native vegetation is 40 inches. Runoff is slow. Wind and water erosion are moderate hazards. Very gravelly sand at a depth of less than 20 inches causes this soil to be droughty. This soil is subject to occasional flooding in spring.

The Straw and Nesda soils are very poorly suited to use as cropland because they are dissected by numerous channels.

These soils are suited to use as rangeland and are used as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, green needlegrass, and basin wildrye and an increase of plants such as fringed sagewort, needleandthread, blue grama, common snowberry, and big sagebrush. Weedy plants that are likely to invade are Kentucky bluegrass, broom snakeweed, annual grasses, and Hood phlox. Forage production is 2,000 pounds per acre in favorable years and 1,200 pounds per acre in unfavorable years.

These soils are not suitable for windbreaks because they are dissected by numerous stream channels.

Occasional flooding imposes serious limitations to the use of these soils for urban development.

Capability subclass VIw, dryland; Overflow range site, 15- to 19-inch precipitation zone.

119—Telstad loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to undulating soil that formed in glacial till on glaciated uplands. The elevation is 2,400 to 3,600 feet. Slopes are mainly long. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is brown loam 7 inches thick. The subsoil is brown and pale brown clay loam 11 inches thick. The upper part of the substratum is light brownish gray clay loam 27 inches thick. The lower part is light yellowish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Assinniboine, Joplin, and Nishon soils are included with this soil in mapping. The Nishon soil is level or nearly level. It is in small enclosed basins that are subject to ponding.

The Telstad soil is used for dryland crops and irrigated alfalfa. It is also used as rangeland. The main dryland crops are wheat, barley, and oats. Wind erosion is the main limitation to use of this soil for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, prairie junegrass, threadleaf sedge, blue grama, and fringed sagewort increase. Weedy plants that are likely to invade are annual grasses, broom snakeweed, and clubmoss. Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 10- to 14-inch precipitation zone.

120—Telstad-Joplin loams, 0 to 4 percent slopes. This complex consists of nearly level to undulating Telstad soil and undulating Joplin soil on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Telstad soil makes up about 55 percent of this map unit, and the Joplin soil makes up 30 percent. Included with these soils in mapping are small areas of Assinniboine, Attewan, Wabek, and Nishon soils. These soils make up about 15 percent of the map unit. The undulating Assinniboine soil is on the upper part of slopes. The nearly level to undulating Wabek soil is on small terraces. The level to nearly level Nishon soil is in basins, and it is subject to ponding.

The Telstad soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is brown loam 7 inches thick. The subsoil is brown and pale brown clay loam 11 inches thick. The upper part of the substratum is light brownish gray clay loam 27 inches thick. The lower part is light yellowish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Joplin soil is deep and well drained. It formed in glacial till on ridges, knolls, and the upper part of slopes. Typically, the surface layer is grayish brown loam 6 inches thick. The upper part of the subsoil is dark brown clay loam 3 inches thick. The lower part is grayish brown loam 7 inches thick. The substratum is grayish brown loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The soils in this complex are used for dryland crops and irrigated alfalfa. In some areas, they are used as rangeland. The main dryland crops are wheat, barley, and oats.

Wind erosion is the main limitation to use of these soils for cultivated crops. Effective in controlling wind erosion are stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue.

The soils in this complex are suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of plants such as needleandthread, blue grama, fringed sagewort, annual grasses, broom snakeweed, and clubmoss.

Forage production on the Telstad and Joplin soils is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a very serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; and thus forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland, and IIe, irrigated; Silty range site, 10- to 14-inch precipitation zone.

121—Telstad-Joplin loams, 4 to 8 percent slopes. This complex consists of gently rolling soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Telstad soil makes up about 45 percent of the map unit, and the Joplin soil makes up 40 percent. Included with these soils in mapping are small areas of Assinniboine, Hillon, Nishon, and Wabek soils. These soils make up about 15 percent of the map unit. The gently rolling Assinniboine soil is on the upper part of slopes. The Hillon soil is on the top of knolls and ridges. The Nishon soil is in small enclosed basins that are subject to ponding. The gently rolling Wabek soil is on the upper part of slopes.

The Telstad soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is brown loam 7 inches thick. The subsoil is brown and pale brown clay loam 11 inches thick. The upper part of the substratum is light brownish gray clay loam 27 inches thick. The lower part is light yellowish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Joplin soil is deep and well drained. It formed in glacial till on ridges, knolls, and the upper part of slopes. Typically, the surface layer is grayish brown loam 6 inches thick. The upper part of the subsoil is dark brown clay loam 3 inches thick. The lower part is grayish brown loam 7 inches thick. The substratum is grayish brown loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The soils in this complex are used for dryland crops and as rangeland. The main dryland crops are wheat, barley, and oats.

Wind and water erosion are the main limitations to use of these soils for cultivated crops. Effective in controlling wind and water erosion are stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways.

These soils are suited to use as rangeland. The potential plant community consists of mainly western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. If the rangeland is overgrazed, western wheatgrass and green needlegrass decrease and needleandthread, prairie junegrass, threadleaf sedge, blue grama, and fringed sagewort increase. Weedy plants likely to invade are annual grasses, broom snakeweed, and clubmoss.

Forage production on the Telstad and Joplin soils is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

122—Telstad-Joplin gravelly loams, 0 to 4 percent slopes. This complex consists of nearly level to undulating soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Telstad soil makes up about 45 percent of this map unit, and the Joplin soil makes up 40 percent. Included with these soils in mapping are small areas of Assinniboine, Attewan, and Wabek soils. These soils make up about 15 percent of the map unit. The undulating Assinniboine soil is on the upper part of slopes. The nearly level and undulating Wabek soil is on small terraces.

The Telstad soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer is grayish brown gravelly loam 7 inches thick. The subsoil is mostly grayish brown and pale brown clay loam 11 inches thick. The substratum is light brownish gray clay loam and light yellowish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Joplin soil is deep and well drained. It formed in glacial till on ridges, knolls, and the upper part of slopes. Typically, the surface layer is grayish brown gravelly loam 6 inches thick. The upper part of the subsoil is dark brown clay loam 3 inches thick, and the lower part is grayish brown loam 7 inches thick. The substratum is grayish brown loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The soils in this complex are used for dryland crops and as rangeland. The main dryland crops are wheat, barley, and oats.

Wind erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue are effective in controlling wind erosion.

These soils are suited to use as rangeland. The potential plant community on the Telstad and Joplin soils consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of plants such as needleandthread, blue grama, fringed sagewort, annual grasses, broom snakeweed, and clubmoss. Forage production on the Telstad and Joplin soils is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a very serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

The soils in this complex can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

123—Thoeny-Elloam complex, 0 to 4 percent slopes. This complex consists of nearly level to undulating soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Thoeny soil makes up about 60 percent of the map unit, and the Elloam soil makes up 30 percent. Included with these soils in mapping are small areas of Kevin, Nobe, and Phillips soils. These soils make up about 10 percent of the map unit. The Nobe soil is in small, nearly barren depressions.

The Thoeny soil is deep and well drained. It formed in glacial till, and it is in smooth areas. Typically, the upper part of the surface layer is pale brown loam 3 inches thick. The lower part is light brownish gray loam 3 inches thick. The upper part of the subsoil is brown clay 6 inches thick. The lower part is grayish brown clay loam 16 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil of the Thoeny soil is slightly affected by sodium at a depth of about 6 inches; consequently, crop yields are reduced.

The Elloam soil is deep and well drained. It formed in glacial till in small, sparsely vegetated depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is light brownish gray clay loam. The subsoil is grayish brown clay loam 10 inches thick. The substratum is mostly grayish brown clay loam to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. The subsoil of the Elloam soil is moderately affected by sodium, and the surface is subject to crusting; consequently, the emergence of seedlings is impeded and crop yields are reduced. Applications of manure or other organic matter help reduce surface crusting.

The soils in this complex are used mainly as rangeland. In some areas the soils are used for dryland crops, mainly wheat, barley, and oats. Wind erosion is the main limitation to use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

These soils are suited to use as rangeland. Most of the forage is produced on the Thoeny soil. The potential plant community on the Thoeny soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. On the Elloam soil it consists of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needlegrass, and Nuttall saltbush and an increase of needleandthread, blue grama, fringed sagewort, prairie junegrass, annual grasses, broom snakeweed, plains pricklypear, and clubmoss.

On the Thoeny soil, the potential plant community produces 1,500 pounds of forage per acre in favorable years and 800 pounds per acre in unfavorable years. On the Elloam soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. Because the subsoil of the Thoeny soil is slightly affected by sodium and that of the Elloam soil is moderately affected, the choice of shrubs and trees is restricted to those that are resistant to sodium. Suitable trees include Russian-olive and Siberian elm, and suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry.

The very slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the very slow permeability.

Capability subclass IVe, dryland. Thoeny soil is in Silty range site, 10- to 14-inch precipitation zone; Elloam soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

124—Thoeny-Kevin-Elloam complex, 4 to 8 percent slopes. This complex consists of gently rolling soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Thoeny soil makes up about 35 percent of this map unit, and the Kevin soil and the Elloam soil each make up about 25 percent. Included with these soils in mapping are small areas of Phillips soil. This soil makes up about 15 percent of the map unit.

The Thoeny soil is deep and well drained. It formed in glacial till, and it is on the smoother part of slopes. Typically, the upper part of the surface layer is pale brown loam 3 inches thick, and the lower part is light gray loam 3 inches thick. The upper part of the subsoil is brown clay 6 inches thick. The lower part is grayish brown clay loam 16 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 28 inches. Runoff is medium. Wind and water erosion are moderate hazards. The subsoil of the Thoeny soil is slightly affected by sodium at a depth of about 6 inches; consequently, crop yields are reduced.

The Kevin soil is deep and well drained. It formed in glacial till on the upper part of ridges and knolls. Typically, the surface layer, where it is mixed to a depth

of about 7 inches, is grayish brown clay loam. The subsoil is grayish brown clay loam 9 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Elloam soil is deep and well drained. It formed in glacial till in small, sparsely vegetated depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is light brownish gray clay loam. The subsoil is grayish brown clay loam 10 inches thick. The substratum is mostly grayish brown clay loam to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth of the soil under native vegetation is 28 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The subsoil of the Elloam soil is moderately affected by sodium and the surface is subject to crusting; consequently, seedling emergence is impeded and crop yields are reduced. Applications of manure or other organic matter help reduce surface crusting.

In some areas the soils in this complex are used for dryland crops, mainly wheat, barley, and oats. Wind and water erosion are the main limitations to use of these soils for cultivated crops. Stripcropping, tall-grass barriers, minimum tillage, and stubble mulch tillage can effectively control wind and water erosion.

The soils in this complex are suited to use as rangeland and are used mainly as rangeland. Most of the forage is produced on the Thoeny and Kevin soils. The potential plant community on the Thoeny and Kevin soils consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs; on the Elloam soil it consists of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, greaseweed, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needlegrass, and Nuttall saltbush and an increase of needleandthread, blue grama, fringed sagewort, prairie junegrass, annual grasses, broom snakeweed, plains pricklypear, and clubmoss.

On the Thoeny and Kevin soils, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Elloam soil, forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. Because the subsoil of the Thoeny soil is slightly affected by sodium and the subsoil of the Elloam soil is moderately affected by sodium, the choice of shrubs and trees is restricted to those that are resistant to sodium. Suitable trees for the Thoeny and Elloam soils include Russian-olive and Siberian elm, and suitable shrubs include Siberian peashrub, skunkbush sumac, and silver buffaloberry. Suitable trees for the Kevin soil are Russian-olive, Siberian elm, green ash, ponderosa pine, and Rocky Mountain juniper, and suitable shrubs are Siberian peashrub, common chokecherry, and lilac.

The very slow permeability of the Thoeny and Elloam soils and the slow permeability of the Kevin soil limit these soils for most urban uses. Septic tank absorption fields require special design because of the very slow and slow permeability.

Capability subclass IVe, dryland. Thoeny and Kevin soils are in Silty range site, 10- to 14-inch precipitation zone; Elloam soil is in Dense Clay range site, 10- to 14-inch precipitation zone.

125—Turner loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil that formed in alluvium on fans and terraces on uplands. The elevation is 2,800 to 4,200 feet. Slopes are mainly long. The average annual precipitation is 15 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil, where it is mixed to a depth of about 4 inches, is dark grayish brown loam. The upper part of the subsoil is dark grayish brown and dark brown clay loam 3 inches thick. The lower part is brown sandy clay loam 4 inches thick. The upper part of the substratum is light gray clay loam 5 inches thick, and the middle part is light gray gravelly sandy clay loam 10 inches thick. The lower part of the substratum, to a depth of 60 inches, is grayish brown very gravelly loamy coarse sand.

Permeability is moderate to a depth of about 26 inches and rapid below that depth. The available water capacity is low or moderate. The effective rooting depth is about 30 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Beaverton, Martinsdale, and Work soils are included with this soil in mapping. The nearly level and gently sloping Beaverton soil is on the top of knolls and ridges.

This Turner soil is used as rangeland and for dryland crops and irrigated alfalfa for hay. The main dryland crops are wheat, oats, and barley.

Wind erosion is the main limitation to the use of this soil for cultivated crops. Stripcropping, tall-grass barriers,

field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, Idaho fescue, and ponderosa pine. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil. Weedy plants likely to invade are clubmoss, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. The potential heavy infestation by clubmoss is a very serious problem. Forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Its low to moderate available water capacity restricts the choice of shrubs and trees to those that are drought resistant. Suitable trees include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and sandcherry.

This soil is suited to most urban uses. Underground water supplies can be polluted by liquid and solid waste disposal systems because of the rapid permeability of the substratum.

Capability subclass IIIs, dryland, and IIs, irrigated; Silty range site, 15- to 19-inch precipitation zone.

126—Turner-Beaverton complex, 2 to 8 percent slopes. This complex consists of undulating to gently rolling soils on terraces and fans on uplands. The elevation is 2,800 to 4,200 feet. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Turner soil makes up about 50 percent of this map unit, and the Beaverton soil makes up 35 percent. Included with these soils in mapping are small areas of Martinsdale and Wabek soils. These soils make up about 15 percent of the map unit. The Wabek soil is on knolls and on the edge of terraces.

The Turner soil is deep and well drained. It formed in alluvium on the lower part of slopes. Typically, the surface layer, where it is mixed to a depth of about 4 inches, is dark grayish brown loam. The upper part of the subsoil is dark grayish brown and dark brown clay loam 3 inches thick. The lower part is brown sandy clay loam 4 inches thick. The upper part of the substratum is light gray clay loam 5 inches thick, and the middle part is light gray gravelly sandy clay loam 10 inches thick. The lower part of the substratum, to a depth of 60 inches, is mostly grayish brown very gravelly loamy coarse sand.

Permeability is moderate to a depth of about 26 inches and rapid below that depth. The available water capacity is low or moderate. The effective rooting depth is about 30 inches. The average annual wetting depth of the soil under native vegetation is 26 inches. Runoff is slow. Wind and water erosion are moderate hazards. Very gravelly loamy coarse sand is at a depth of about 26 inches.

The Beaverton soil is deep and well drained. It formed in alluvium on fans and terraces. Typically, the surface layer is dark grayish brown gravelly loam 3 inches thick. The subsoil is dark brown gravelly clay loam 7 inches thick. The upper part of the substratum is light gray very gravelly clay loam 6 inches thick. Below that, to a depth of 60 inches, the substratum is grayish brown very gravelly loamy sand.

Permeability is moderate to a depth of about 20 inches and very rapid or rapid below that depth. The available water capacity is low. The effective rooting depth is about 20 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. Very gravelly loamy sand is at a depth of about 20 inches; consequently, this soil is too droughty for dryland crops.

In some small areas, these soils are used for dryland crops, mainly wheat, barley, and oats. Wind erosion and droughtiness are the main limitations to use of these soils for cultivated crops. Effective in controlling wind erosion are stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue.

The soils in this complex are suited to use as rangeland and are used mainly as rangeland. Most of the forage is produced on the Turner soil. The potential plant community on the Turner soil consists mainly of rough fescue, bluebunch wheatgrass, and green needlegrass. Sedges, forbs, and some woody plants are decreasers. The potential plant community on the Beaverton soil consists mainly of bluebunch wheatgrass, green needlegrass, needleandthread, and western wheatgrass. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of threadleaf sedge, needleandthread, western wheatgrass, blue grama, fringed sagewort, Kentucky bluegrass, timothy, annual grasses, red threeawn, broom snakeweed, and Hood phlox.

On the Turner soil, forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Beaverton soil, forage production is 900 pounds per acre in favorable years and 500 pounds per acre in unfavorable years.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Because the Turner soil has low or moderate available water capacity and the Beaverton soil has low available water capacity, the choice of shrubs and trees is restricted to those that are drought resistant. Suitable trees on the Turner soil include Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, and silver buffaloberry. Suitable trees on the Beaverton soil include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

These soils are suited to most urban uses. Underground water supplies can be polluted by liquid and solid waste from sanitary disposal systems because of the rapid permeability of the substratum.

Capability subclass IVe, dryland. Turner soil is in Silty range site, 15- to 19-inch precipitation zone; Beaverton soil is in Shallow to Gravel range site, 15- to 19-inch precipitation zone.

127—Twilight-Riedel fine sandy loams, 4 to 8 percent slopes. This complex consists of gently rolling soils on uplands. The elevation is 2,800 to 4,000 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Twilight soil makes up about 50 percent of this map unit, and the Riedel soil makes up 35 percent. Included with these soils in mapping are small areas of Cabbart, Chinook, and Delpoint soils. These soils make up about 15 percent of the map unit.

The Twilight soil is moderately deep and well drained. It formed on the lower slopes and swales in material that weathered from soft sandstone. Typically, the surface layer is grayish brown fine sandy loam 3 inches thick. The subsoil is brown fine sandy loam 8 inches thick. The substratum is pale olive fine sandy loam 24 inches thick. Below that, there is soft sandstone to a depth of 60 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 35 inches. The average annual wetting depth of the soil under native vegetation is 35 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a moderate hazard. Soft sandstone is at a depth of 20 to 40 inches.

The Riedel soil is moderately deep and well drained. It formed on the upper slopes of ridges and knolls in material that weathered from soft sandstone. Typically, the surface layer is grayish brown fine sandy loam 5 inches thick. The upper part of the substratum is light yellowish brown fine sandy loam 12 inches thick. The lower part, which is 7 inches thick, is strongly weathered sandstone that contains roots. Below that, to a depth of 60 inches, the substratum is sandstone.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 24 inches. The average annual wetting depth of the soil under native vegetation is 24 inches. Runoff is slow. Wind erosion is a severe hazard, and water erosion is a slight hazard. Strongly weathered sandstone is at a depth of 10 to 20 inches; soft sandstone is at a depth of 20 to 40 inches.

In some small areas, the soils in this complex are used for dryland crops, including wheat, barley, and oats. Wind and water erosion and droughtiness are the main limitations to use of these soils for cultivated crops. Effective in controlling wind and water erosion are stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways. A permanent and adequately maintained cover of planted grasses or of natural vegetation also helps control erosion.

These soils are suited to use as rangeland and are used mostly as rangeland. Most of the forage is produced on the Twilight soil. The potential plant community on the Twilight soil consists mainly of Indian ricegrass, prairie sandreed, needleandthread, western wheatgrass, and bluebunch wheatgrass. The potential plant community on the Riedel soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass, western wheatgrass, Indian ricegrass, and prairie sandreed and an increase of plants such as blue grama, threadleaf sedge, annual grasses, prairie junegrass, fringed sagewort, yucca, broom snakewood, clubmoss, and plains pricklypear.

On the Twilight soil, forage production is 1,600 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Riedel soil, forage production is 800 pounds per acre in favorable years and 400 pounds per acre in unfavorable years.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

The Twilight soil can be used for windbreaks. The very low available water capacity of the Riedel soil makes it unsuitable for windbreaks. Suitable trees on the Twilight soil include Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The soft sandstone at a depth of 20 to 40 inches limits these soils for most urban uses. Septic tank absorption fields require special design because of the soft sandstone.

Capability subclass IVe, dryland. Twilight soil is in Sandy range site, 10- to 14-inch precipitation zone; Riedel soil is in Shallow range site, 10- to 14-inch precipitation zone.

128—Twilight-Riedel fine sandy loams, 8 to 20 percent slopes. This complex consists of strongly rolling to hilly soils on uplands. The elevation is 2,800 to 4,000 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Twilight soil makes up about 40 percent of this map unit, and the Riedel soil makes up 40 percent. Included with these soils in mapping, and making up about 20 percent of the map unit, are small areas of Cabbart and Chinook soils and areas of Rock outcrop.

The Twilight soil is moderately deep and well drained. It formed on lower slopes and swales in material that weathered from soft sandstone. Typically, the surface layer is grayish brown fine sandy loam 3 inches thick. The subsoil is brown fine sandy loam 8 inches thick. The substratum is pale olive fine sandy loam 24 inches thick. Below that, there is soft sandstone to a depth of 60 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 35 inches. The average annual wetting depth of the soil under native vegetation is 35 inches. Runoff is medium. Wind erosion is a severe hazard, and water erosion is a moderate hazard. Soft sandstone is at a depth of 20 to 40 inches.

The Riedel soil is moderately deep and well drained. It formed on the upper slopes of ridges, hills, and knolls in material that weathered from soft sandstone. Typically, the surface layer is grayish brown fine sandy loam 5 inches thick. The upper part of the substratum is light yellowish brown fine sandy loam 12 inches thick. The lower part, which is 7 inches thick, is strongly weathered sandstone that contains roots. Below that, to a depth of 60 inches, the substratum is soft sandstone.

Permeability is moderately rapid, and the available water capacity is very low. The effective rooting depth is about 24 inches. The average annual wetting depth of the soil under native vegetation is 24 inches. Runoff is medium. Wind erosion is a severe hazard, and water erosion is a moderate hazard. Strongly weathered sandstone is at a depth of 10 to 20 inches; soft sandstone is at a depth of 20 to 40 inches.

The soils in this complex are not suited to cultivated crops because of the very low available water capacity of the Riedel soil.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Twilight soil. The potential plant community on the Twilight soil consists mainly of Indian ricegrass, prairie sandreed, needleandthread, western wheatgrass, and bluebunch wheatgrass. The potential plant community on the Riedel soil consists mainly of bluebunch wheatgrass, western wheatgrass, needleandthread, prairie sandreed, and plains muhly. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass, western wheatgrass, Indian ricegrass, and prairie sandreed and an increase of plants such as blue grama, annual grasses, threadleaf sedge, prairie junegrass, fringed sagewort, broom snakeweed, yucca, clubmoss, and plains pricklypear.

On the Twilight soil, forage production is 1,600 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. On the Riedel soil, forage production is 800 pounds per acre in favorable years and 400 pounds per acre in unfavorable years.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The Twilight soil can be used for windbreaks. The very low available water capacity of the Riedel soil makes it unsuited to windbreaks. Suitable trees on the Twilight soil are Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, silver buffaloberry, and sandcherry.

The soils in this complex are poorly suited to timber production. There are, however, some ponderosa pine and juniper trees.

The soft sandstone at a depth of 20 to 40 inches and the steepness of the slopes limit these soils for most urban uses. Septic tank absorption fields require special design because of the slopes and the soft sandstone.

Capability subclass VIe, dryland. Twilight soil is in Sandy range site, 10- to 14-inch precipitation zone; Riedel soil is in Shallow range site, 10- to 14-inch precipitation zone.

129—Typic Fluvaquents, 0 to 2 percent slopes. This map unit consists of nearly level soils on bottom lands and flood plains mainly in the Milk River Valley. These soils in most places are deep, somewhat poorly drained or poorly drained silty clay loams and silty clays that formed in alluvium. They have a high seasonal water table, usually in the irrigation season. The landscape consists mainly of low areas, sloughs, and areas below irrigation canals. The elevation is 2,300 to 2,500 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The available water capacity is moderate or high. Runoff is slow. Water erosion is a slight hazard.

Included in mapping are small areas of moderately well drained soils.

Typic Fluvaquents are not suited to cultivated crops because of wetness and the hazard of flooding.

These soils are suited to use as rangeland and are used as rangeland. They are also suited to use as wildlife habitat.

The potential plant community consists mainly of sedges and rushes. Excessive grazing results in a decrease of desirable plants and an increase of plants such as Baltic rush and cattails. Weedy plants that are likely to invade with continued grazing pressure are foxtail barley, sunflowers, and dandelions. The potential plant community produces 5,000 pounds of forage per acre in favorable years and 3,000 pounds per acre in unfavorable years. If feasible, sealing irrigation canals and providing a well designed drainage system lowers

the water table and provides a more favorable site for desirable plants.

The soils in this unit are not suited to windbreaks because of wetness. Flooding and wetness seriously limit these soils for most urban uses.

Capability subclass Vw, irrigated; Wetland range site, 10- to 14-inch precipitation zone.

130—Typic Ustifluvents, wet. This map unit consists of nearly level to gently sloping soils on bottom lands and stream terraces in narrow valleys and drainageways. In small areas the soils are on multilevel terraces and short, steep slopes. These soils in most places are deep and moderately well drained or somewhat poorly drained loams and clay loams that formed in alluvium. They are subject to flooding in periods of high seasonal runoff, and in the lower areas they have a high seasonal water table. The landscape is dissected by stream channels and drainageways. The elevation is 2,600 to 5,000 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 115 days.

The available water capacity is high. Runoff is slow or medium. Wind and water erosion are moderate hazards.

Included in mapping are small areas of well drained loam and clay loam soils and soils that are underlain by very gravelly material at a depth of 10 to 40 inches.

Typic Ustifluvents are not suited to cultivated crops because of occasional flooding, wetness, and the dissected pattern of the landscape.

These soils are suited to use as rangeland, and they are used as rangeland. The potential plant community consists mainly of basin wildrye, tall sedges, western wheatgrass, Canby bluegrass, and plains cottonwood. Forbs and some woody plants are decreasers. Excessive grazing results in a decrease of desirable plants such as basin wildrye and tall sedges and an increase of western wheatgrass, sedges, and woody plants. Weedy plants likely to invade with continued grazing pressure are foxtail barley, quackgrass, and Baltic rush. The potential plant community produces 4,500 pounds of forage per acre in favorable years and 2,500 pounds per acre in unfavorable years.

These soils are poorly suited to windbreaks. The dissected landscape makes planting difficult. Flooding and the seasonal water table in some areas restrict the choice of trees and shrubs that can be grown. Suitable shrubs include common chokecherry, American plum, and silver buffaloberry. Suitable trees include Russian-olive and Siberian elm.

Occasional flooding seriously limits these soils for most urban uses.

Capability subclass Vlw, irrigated; Subirrigated range site, 15- to 19-inch precipitation zone.

131—Ustic Torrifluvents, wet. This map unit consists of nearly level to gently sloping loam and clay loam soils that formed in alluvium. The soils are on bottom lands and stream terraces in narrow valleys. The areas are dissected by stream channels and drainageways; in some small areas there are multilevel terraces and short, steep slopes. The soils are mainly deep, moderately well drained or somewhat poorly drained, and moderately affected by salts. They are subject to flooding in periods of high seasonal runoff, and in the lower areas they have a high seasonal water table.

These soils are at an elevation of 2,300 to 3,800 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

These soils have moderate or high available water capacity. Runoff is slow or medium. Wind and water erosion are moderate hazards.

Included in mapping are small areas of well drained loam and clay loam soils and soils that are underlain by very gravelly material at a depth of 10 to 40 inches.

The soils in this unit are not suited to cultivated crops because of flooding, wetness, and the dissected pattern of the landscape.

These soils are suited to use as rangeland, and they are used as rangeland. The potential plant community consists mainly of basin wildrye, western wheatgrass, alkali cordgrass, alkali sacaton, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as basin wildrye, alkali cordgrass, and alkali sacaton and an increase of inland saltgrass, silver sage, needleandthread, fringed sagewort, foxtail barley, quackgrass, and broom snakeweed. Forage production is 4,500 pounds per acre in favorable years and 2,500 pounds per acre in unfavorable years.

These soils are poorly suited to windbreaks. The dissected pattern makes the planting of windbreaks difficult. These soils are moderately affected by salts, and only trees and shrubs that tolerate salts should be selected. Suitable shrubs include common chokecherry, American plum, and silver buffaloberry. Suitable trees include Russian-olive and Siberian elm.

Occasional flooding and wetness limit the use of these soils for most urban uses.

Capability subclass Vlw; Subirrigated range site, 10- to 14-inch precipitation zone.

132—Vanda clay, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil that formed in clay alluvium on fans and terraces in valleys and on uplands. The elevation is 2,300 to 3,300 feet. Slopes are mainly medium in length. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown clay 6 inches thick; it has a thin light brownish gray vesicular crust 1/4- to 1/2-inch thick. The substratum is olive gray clay to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow.

Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is strongly affected by sodium and is subject to surface crusting; consequently, seedling emergence is impeded and crop yields are reduced.

Small areas of Marvan and Nobe soils are included with this soil in mapping.

Because this soil is strongly affected by sodium, it is very poorly suited to cultivated crops.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needlegrass, and Nuttall saltbush and an increase of plants such as prairie junegrass, inland saltgrass, foxtail barley, curlycup gumweed, plains pricklypear, and broom snakeweed. Forage production is 800 pounds per acre in favorable years and 300 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil is not suited to windbreaks because it is strongly affected by sodium.

The very slow permeability and high shrink-swell potential limit this soil for most urban uses. Septic tank absorption fields require special design because of the very slow permeability. Foundations and basements for houses require special design because of the high shrink-swell potential.

Capability subclass VIs, dryland; Dense Clay range site, 10- to 14-inch precipitation zone.

133—Vanda-Nobe clays, 0 to 2 percent slopes. This complex consists of soils on fans and terraces in valleys and on uplands. The elevation is 2,300 to 3,300 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Vanda soil makes up about 55 percent of the map unit, and the Nobe soil makes up 25 percent. Included with these soils in mapping are small areas of Absher, Benz, and Marvan soils. These soils make up about 20 percent of the map unit.

The Vanda soil is deep and well drained. It formed in clayey alluvium in smooth areas. Typically, a thin, light brownish gray vesicular crust that is 1/4- to 1/2-inch thick is on the surface. Below that, the surface layer is grayish brown clay 6 inches thick. The substratum is olive gray clay to a depth of 60 inches.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard. This soil is strongly affected by sodium and is subject to crusting at the surface; consequently, seedling emergence is impeded and crop yields are reduced.

The Nobe soil is deep and well drained. It formed in alluvium in depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay. The substratum is grayish brown clay to a depth of 30 inches and, below that, olive silty clay to a depth of 60 inches.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 60 inches, but the subsoil, which is strongly affected by sodium, is very hard when dry; thus, root penetration is impeded. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Because these soils are strongly affected by sodium, they are very poorly suited to cultivated crops.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Vanda soil. The potential plant community on the Vanda soil consists mainly of green needlegrass, western wheatgrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. The potential plant community on the Nobe soil consists of western wheatgrass, green needlegrass, prairie junegrass, Sandberg bluegrass, inland saltgrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needleandthread, prairie junegrass, Sandberg bluegrass, and inland saltgrass. Foxtail barley, curlycup gumweed, plains pricklypear, and broom snakeweed are likely to invade.

On the Vanda soil, the potential plant community produces 800 pounds of forage per acre in favorable years and 300 pounds per acre in unfavorable years. On the Nobe soil, forage production is 200 pounds per acre in favorable years and 75 pounds per acre in unfavorable years.

The soils in this complex are not suited to windbreaks because they are strongly affected by sodium.

The high shrink-swell potential and very slow permeability of these soils and the low strength of the Nobe soil are limitations for most urban uses. Septic tank absorption fields require special design because of the very slow permeability. Foundations and basements for houses require special design because of the low strength and high shrink-swell potential.

Capability subclass VIIs, dryland. Vanda soil is in Dense Clay range site, 10- to 14-inch precipitation zone; Nobe soil is in Saline Upland range site, 10- to 14-inch precipitation zone.

134—Vanda-Nobe clays, 2 to 8 percent slopes. This complex consists of soils on fans and terraces in valleys and on uplands. The elevation is 2,300 to 3,300 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Vanda soil makes up about 60 percent of the map unit, and the Nobe soil makes up 25 percent. Included

with these soils in mapping are small areas of Bascovy, Dilts, Lisam, and Marvan soils. These soils make up about 15 percent of the map unit.

The Vanda soil is deep and well drained. It formed in clayey alluvium in smooth areas. Typically, a thin light brownish gray vesicular crust that is 1/4- to 1/2-inch thick is on the surface. Below that, the surface layer is dark grayish brown clay 6 inches thick. The substratum is olive gray clay to a depth of 60 inches.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion are moderate hazards. This soil is strongly affected by sodium and is subject to crusting at the surface; consequently, seedling emergence is impeded and crop yields are reduced.

The Nobe soil is deep and well drained. It formed in alluvium in depressions. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay. The upper part of the substratum is grayish brown clay 23 inches thick, and the lower part is olive silty clay to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is about 60 inches, but the subsoil, which is strongly affected by sodium, is very hard when dry; thus, root penetration is impeded. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is medium or rapid. Wind and water erosion are moderate hazards.

Because these soils are strongly affected by sodium, they are very poorly suited to cultivated crops.

These soils are suited to use as rangeland, and they are used as rangeland. Most of the forage is produced on the Vanda soil. The potential plant community on the Vanda soil consists mainly of green needlegrass, western wheatgrass, Nuttall alkaligrass, Nuttall saltbush, greasewood, and forbs. The potential plant community on the Nobe soil consists of western wheatgrass, green needlegrass, prairie junegrass, Sandberg bluegrass, inland saltgrass, Nuttall saltbush, greasewood, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, green needlegrass, Nuttall saltbush, and greasewood and an increase of needleandthread, prairie junegrass, Sandberg bluegrass, and inland saltgrass. Foxtail barley, curlycup gumweed, plains pricklypear, and broom snakeweed are likely to invade.

On the Vanda soil, the potential plant community produces 800 pounds of forage per acre in favorable years and 300 pounds per acre in unfavorable years. On the Nobe soil, forage production is 200 pounds per acre in favorable years and 75 pounds per acre in unfavorable years.

The soils in this complex are not suited to windbreaks because they are strongly affected by sodium.

The high shrink-swell potential and very slow permeability of these soils and the low strength of the Nobe soil are limitations for most urban uses. Septic tank absorption fields require special design because of very slow permeability. Foundations and basements for houses require special design because of the low strength and high shrink-swell potential.

Capability subclass VIIs, dryland. Vanda soil is in Dense Clay range site, 10- to 14-inch precipitation zone; Nobe soil is in Saline Upland range site, 10- to 14-inch precipitation zone.

135—Vida clay loam, 4 to 8 percent slopes. This is a deep, well drained, gently rolling soil that formed in glacial till on glaciated uplands. The soil is at an elevation of 2,400 to 3,800 feet. Slopes are mainly short. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer, where it is mixed to a depth of about 7 inches, is dark grayish brown clay loam. The subsoil is mostly brown clay loam 7 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

Small areas of Dimmick, Nishon, Zahill, and Bearpaw soils are included with this soil in mapping. The nearly level Dimmick and Nishon soils are in depressions and are subject to ponding. The strongly sloping Zahill soil is on ridges.

The Vida soil is used for dryland crops and as rangeland. Dryland crops are mainly wheat, barley, and oats. Wind and water erosion are the main limitations to use of this soil for cultivated crops. Stripcropping, field windbreaks, tall wheatgrass barriers, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion. Water erosion damage is reduced by establishing grassed waterways, by maintaining crop residue, or by stripcropping on the contour.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. Excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of blue grama, prairie junegrass, needleandthread, western wheatgrass, fringed sagewort, common snowberry, shrubby cinquefoil, Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss.

Forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation

before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, allows desirable native plants to become reestablished, and thus increases forage production.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

136—Vida-Zahill clay loams, 8 to 15 percent slopes. This complex consists of strongly rolling soils on glaciated uplands. The elevation is 2,400 to 3,800 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Vida soil makes up about 45 percent of this map unit, and the Zahill soil makes up 45 percent. Included in mapping are small areas of Bearpaw and Williams soils. These soils make up about 10 percent of the map unit.

The Vida soil is deep and well drained. It formed in glacial till on the lower part of slopes. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is dark grayish brown clay loam. The subsoil is mostly brown clay loam 7 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Zahill soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium or rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The soil is calcareous throughout.

In some areas these soils are used for dryland crops, mainly wheat and barley. Wind and water erosion are the main limitations to use of these soils for cultivated crops. Effective in controlling wind and water erosion are stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways. A permanent and adequately maintained cover of planted grasses or of natural vegetation helps to control wind and water erosion. Crop yields can be increased on the calcareous Zahill soil by additions of phosphate fertilizers.

These soils are suited to use as rangeland and are used mainly as rangeland. The potential plant community on the Vida soil consists of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs and some woody plants are decreasers. The potential plant community on the Zahill soil consists of bluebunch wheatgrass and little bluestem. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of plants such as Idaho fescue, needleandthread, prairie junegrass, western wheatgrass, fringed sagewort, blue grama, common snowberry, threadleaf sedge, shrubby cinquefoil, Kentucky bluegrass, annual grasses, Hood phlox, pussytoes, and clubmoss.

On the Vida soil, forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years. On the Zahill soil, forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a very serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

The soils in this complex are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slope and slow permeability limit these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IVe, dryland. Vida soil is in Silty range site, 15- to 19-inch precipitation zone; Zahill soil is in Thin Hilly range site, 15- to 19-inch precipitation zone.

137—Wabek gravelly loam, 8 to 35 percent slopes. This is a deep, well drained, strongly sloping to steep soil that formed in alluvium on terraces and on uplands. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is dark grayish brown and dark brown gravelly loam 8 inches thick. The

upper part of the substratum is light brownish gray very gravelly loamy coarse sand 7 inches thick. The lower part, to a depth of 60 inches, is grayish brown very gravelly coarse sand.

Permeability is very rapid, and the available water capacity is very low. The effective rooting depth is about 20 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is medium. Wind erosion is a moderate hazard, and water erosion is a severe hazard. The depth to very gravelly coarse sand is 7 to 20 inches. This soil is very droughty.

Small areas of Beaverell, Beaverton, and Shawmut soils are included with this soil in mapping.

The Wabek soil is not suited to cultivated crops because of droughtiness, steep slopes, and a severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of bluebunch wheatgrass, green needlegrass, needleandthread, and western wheatgrass. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass and green needlegrass and an increase of needleandthread, threadleaf sedge, prairie junegrass, Idaho fescue, blue grama, fringed sagewort, annual grasses, red threeawn, broom snakeweed, Hood phlox, and clubmoss.

Forage production is 900 pounds per acre in favorable years and 500 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a very serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is not suited to windbreaks because it is very droughty.

In areas where slopes are less than 15 percent, this soil is suited to most urban uses. Underground water supplies can be polluted by liquid and solid waste disposal systems because of the very rapid permeability of the substratum. In areas where slopes are more than 15 percent, this soil is seriously limited for most urban uses.

Capability subclass VIs, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone.

138—Warneke-Whitecow-Rock outcrop complex, 35 to 70 percent slopes. This complex consists of steep to very steep Warneke soil, steep to very steep Whitecow soil on south-facing slopes, and Rock outcrop. The elevation is 4,000 to 6,000 feet. The average annual precipitation is 19 inches, and the average annual temperature is 40 degrees F. The average growing season is 90 days.

The Warneke soil makes up about 40 percent of the map unit; the Whitecow soil makes up about 25 percent; and Rock outcrop makes up 20 percent. Included in mapping, and making up about 15 percent of the map unit, are small areas of Whitecow soil on north-facing slopes and Windham soil.

The Warneke soil is shallow and well drained. It formed on mountainsides in material that weathered from hard limestone. Typically, the surface layer is brown gravelly loam 4 inches thick. The subsoil is very pale brown, very channery loam 11 inches thick. Below that, there is limestone bedrock to a depth of 60 inches.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 15 inches. The average annual wetting depth of the soil under native vegetation is 15 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Hard bedrock is at a depth of 10 to 20 inches.

The Whitecow soil is deep and well drained. It formed on mountainsides in colluvium or alluvium derived from limestone. Typically, the surface layer is covered by an organic mat that is 1 inch thick. The upper part of the surface layer is dark grayish brown gravelly loam 3 inches thick. The lower part is grayish brown very gravelly loam 7 inches thick. The subsoil is light brownish gray very gravelly loam 10 inches thick. The substratum is light brownish gray extremely gravelly loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

Rock outcrop is on the crests and tops of mountains. It reduces productivity if the soils in this complex are used as woodland or rangeland.

These soils are suited mainly to use as woodland. A forest fire in 1936 burned most of the trees in the Little Rocky Mountains. A few scattered stands of ponderosa pine and lodgepole pine survived and have provided a seed source for the regeneration of trees. Grasses and shrubs cover most of the area and protect the soils from erosion. They are strong competitors for moisture and nutrients, however, and have delayed the reestablishment of trees in most parts of the Little Rocky Mountains.

The severe hazard of water erosion can be diminished by maintaining a permanent cover of natural vegetation.

These soils are used as rangeland and woodland. The potential forest understory plant community on the Warneke soil and on the Whitecow soil consists mainly of little bluestem, Richardson needlegrass, bluebunch wheatgrass, western wheatgrass, common snowberry, Idaho fescue, common chokecherry, and arrowleaf balsamroot. Continued excessive grazing results in a decrease of desirable plants such as little bluestem,

Richardson needlegrass, and bluebunch wheatgrass and an increase of lupine, arrowleaf balsamroot, Sandberg bluegrass, and Idaho fescue. Weedy plants likely to invade with continued grazing pressure are curlycup gumweed, rubber rabbitbrush, cheatgrass, and annual forbs.

The Warneke soil is capable of producing about 2,300 cubic feet, or 300 board feet (Scribner rule), per acre of ponderosa pine. The Whitecow soil is capable of producing about 3,900 cubic feet, or 7,800 board feet (Scribner rule), per acre of ponderosa pine. These production levels are from fully stocked, even-aged, unmanaged stands of 100-year-old trees.

The steep to very steep slopes and the low and very low available water capacity are limitations to the use of these soils for timber production. The slopes and the outcrops of rock limit the use of equipment and the kind of equipment that can be used in forest management.

Site scarification during harvest and regeneration operations are necessary to reduce plant competition and seedling mortality. To prevent excessive soil erosion, logs should not be skidded in drainageways, and to prevent deeply rutted skid trails from forming, numerous trails should be used in skidding logs.

The warm dry surface layer and the very low and low available water capacity severely reduce seedling survival. The Warneke soil is not suitable for commercial timber production because of low productivity, but timber should be maintained for watershed protection.

These soils are easily eroded if they are disturbed. Erosion control should be considered in choosing equipment and methods of forest management.

The soils in this complex are not suited to windbreaks because the slopes are more than 15 percent.

The steep to very steep slopes limit these soils for most urban uses.

Capability subclass VIIe, dryland.

139—Whitecow-Warneke gravelly loams, 25 to 60 percent slopes. This complex consists of steep to very steep Whitecow soil on south-facing slopes and Warneke soil. The elevation is 4,000 to 6,000 feet. The average annual precipitation is 19 inches, and the average annual temperature is 40 degrees F. The average growing season is 90 days.

The Whitecow soil makes up about 45 percent of this map unit, and the Warneke soil makes up 35 percent. Included with these soils in mapping, and making up about 20 percent of the map unit, are small areas of Whitecow soil on north-facing slopes, Windham soil, and Rock outcrop. Rock outcrop limits the use of equipment.

The Whitecow soil is deep and well drained. It formed in colluvium or alluvium on the lower part of mountainsides; it is on south- and west-facing slopes. Typically, the surface layer is covered by a layer of forest litter and humus that is 1 inch thick. The upper part of the surface layer is grayish brown gravelly loam 3 inches thick. The lower part is grayish brown very gravelly loam 7 inches thick. The subsoil is light brownish gray very gravelly loam 10 inches thick. The substratum is light brownish gray extremely gravelly loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Warneke soil is shallow and well drained. It formed on the upper part of mountain slopes in material that weathered from limestone. Typically, the surface layer is brown gravelly loam 4 inches thick. The subsoil is very pale brown, very channery loam 11 inches thick. Below that, there is limestone bedrock to a depth of 60 inches.

Permeability is moderate, and the available water capacity is very low. The effective rooting depth is about 15 inches. The average annual wetting depth of the soil under native vegetation is 15 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

These soils are used mainly as woodland. A forest fire in 1936 burned most of the trees in the Little Rocky Mountains. A few scattered stands of ponderosa pine and lodgepole pine survived and have provided a source of seed for the regeneration of trees. Grasses and shrubs cover most of the area and protect the soils from erosion. They are strong competitors for moisture and nutrients, however, and have delayed the reestablishment of trees in most parts of the Little Rocky Mountains.

The severe hazard of water erosion can be diminished by adequately maintaining a permanent cover of natural vegetation.

These soils are used as rangeland and woodland. Most of the grazable forage is produced on the Whitecow soil. The potential forest understory plant community on the Whitecow soil and on the Warneke soil consists mainly of bluebunch wheatgrass, common snowberry, common chokecherry, Saskatoon serviceberry, little bluestem, Idaho fescue, arrowleaf balsamroot, Oregon-grape, kinnikinnick, and common juniper. If the density of the overstory canopy is reduced, the amount of forage produced in the understory increases and the composition of the understory changes. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass, little bluestem, and Saskatoon serviceberry and an increase of Idaho fescue, lupine, arrowleaf balsamroot, prairie junegrass, common snowberry, cheatgrass, and weedy forbs.

These soils are suited to the production of ponderosa pine. The Whitecow soil is capable of producing about 3,900 cubic feet, or 7,800 board feet (Scribner rule), per acre of ponderosa pine. The Warneke soil is capable of producing about 2,300 cubic feet, or 300 board feet

(Scribner rule), per acre of noncommercial trees. These production levels are from fully stocked, even-aged, unmanaged stands of 100-year-old trees.

The steep to very steep slope and the low and very low available water capacity are limitations to the use of these soils for timber production. The slopes limit the use of equipment and the kind of equipment that can be used in forest management.

Site scarification during harvest and regeneration operations are necessary to reduce plant competition and seedling mortality. To prevent excessive soil erosion, logs should not be skidded in drainageways, and to prevent deeply rutted skid trails from forming, numerous trails should be used in skidding logs.

The low and very low available water capacity severely reduce seedling survival. The Warneke soil is not suitable for commercial timber production because of low productivity, but timber should be maintained for watershed protection. The Warneke soil is very easily eroded if it is disturbed. Erosion control should be considered in choosing equipment and methods of forest management.

The soils in this complex are not suited to windbreaks because slopes are more than 15 percent.

The steep to very steep slope limits these soils for most urban uses.

Capability subclass VIIe, dryland.

140—Whitecow association, steep. This association consists of Whitecow soils at an elevation of 4,000 to 6,000 feet. The average annual precipitation is 19 inches, and the average annual temperature is 40 degrees F. The average growing season is 90 days.

The Whitecow soil that is mainly on south-facing slopes makes up about 55 percent of this association, and the Whitecow soil that is mainly on north-facing slopes makes up 35 percent. Included in mapping, and making up about 10 percent of the association, are small areas of Warneke soil and small areas of Rock outcrop. The steep to very steep, shallow Warneke soil is on ridges and hills. Rock outcrop is on the crests of ridges and hills.

Whitecow soils are deep and well drained. They formed on mountainsides in colluvium or alluvium derived from limestone. The Whitecow soil on north- and east-facing slopes has a more effective moisture regime than the Whitecow soil on south- and west-facing slopes.

Typically, the Whitecow soil on north-facing slopes has a surface layer that is covered by an organic mat 1 inch thick. The upper part of the surface layer is grayish brown gravelly loam 3 inches thick, and the lower part is grayish brown, very gravelly loam 7 inches thick. The subsoil is light brownish gray, very gravelly loam 10 inches thick. The substratum is light brownish gray, extremely gravelly loam to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The soil is suited mainly to woodland use. A forest fire in 1936 burned most of the trees in the Little Rocky Mountains. A few scattered stands of ponderosa pine, lodgepole pine, and Douglas-fir survived and have provided a source of seed for the regeneration of trees. Grasses and shrubs cover most of the area and protect the soil from erosion. They are strong competitors for moisture and nutrients, however, and have delayed the reestablishment of trees in most parts of the Little Rocky Mountains.

The severe hazard of water erosion can be diminished by maintaining a permanent cover of natural vegetation.

Typically, the Whitecow soil on south-facing slopes has a surface layer that is covered by an organic mat 1 inch thick. The upper part of the surface layer is dark grayish brown gravelly loam 3 inches thick. The lower part is grayish brown, very gravelly loam 7 inches thick. The subsoil is light brownish gray, very gravelly loam 10 inches thick. The substratum is light brownish gray, extremely gravelly loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The soils in this association are used as rangeland and woodland. The potential forest understory plant community on the Whitecow soil on north- and east-facing slopes consists mainly of pinegrass, common snowberry, Oregon-grape, bearded wheatgrass, Columbia needlegrass, blue wildrye, common juniper, arrowleaf balsamroot, white spirea, common chokecherry, russet buffaloberry, twinflower, heartleaf arnica, kinnikinnick, and lupine. The potential forest understory plant community on the Whitecow soil on south- and west-facing slopes consists of bluebunch wheatgrass, Saskatoon serviceberry, little bluestem, skunkbush sumac, and common snowberry. If the density of the forest overstory canopy is reduced, the amount of forage produced in the understory increases and the composition of the understory changes. Continued excessive grazing results in a decrease of desirable plants such as Columbia needlegrass, bluebunch wheatgrass, and blue wildrye and an increase of plants such as common snowberry, arrowleaf balsamroot, lupine, Kentucky bluegrass, timothy, and cheatgrass.

The Whitecow soil on north-facing slopes is suited to the production of Douglas-fir and lodgepole pine. It is capable of producing about 4,665 cubic feet, or 12,570 board feet (Scribner rule), per acre of Douglas-fir and lodgepole pine. The Whitecow soil on south-facing slopes is suited to the production of ponderosa pine. It is capable of producing about 3,900 cubic feet, or 7,800

board feet (Scribner rule), per acre of ponderosa pine. These production levels are from fully stocked, even-aged, unmanaged stands of 100-year-old trees.

The steep slopes and low available water capacity limit these soils for timber production. The slopes limit the kind of equipment that can be used in forest management.

Site scarification during harvest and regeneration operations are necessary to reduce plant competition and seedling mortality. To prevent excessive soil erosion, logs should not be skidded in drainageways, and to prevent deeply rutted skid trails from forming, numerous trails should be used in skidding logs.

The soils are not suited to windbreaks because slopes are more than 15 percent.

The steep slopes limit these soils for most urban uses.

Capability subclass VIIe, dryland.

141—Williams loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to undulating soil that formed in glacial till on glaciated uplands. The elevation is 2,400 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark grayish brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 14 inches thick. The substratum is mostly light brownish gray and grayish brown loam to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Elloam, Dimmick, Nishon, and Vida soils are included with this soil in mapping. The nearly level Elloam soil is in small depressions. It is moderately affected by sodium. The nearly level Dimmick and Nishon soils are in enclosed basins and are subject to ponding.

This Williams soil is used for dryland crops and as rangeland. The main dryland crops are wheat, barley, and oats.

Wind erosion is the main limitation to the use of this soil for cultivated crops. Effective in controlling wind erosion are stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, shrubby cinquefoil, Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. Forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderately slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

142—Williams-Vida loams, 0 to 4 percent slopes. This complex consists of nearly level to undulating soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 15 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Williams soil makes up about 55 percent of this map unit, and the Vida soil makes up 30 percent. Included with these soils in mapping are small areas of Bearpaw, Elloam, Nishon, and Dimmick soils. These soils make up about 15 percent of the map unit. The Elloam soil is moderately affected by sodium. It is in small depressions. The nearly level Nishon and Dimmick soils are in undrained basins.

The Williams soil is deep and well drained. It formed in glacial till. Typically, the surface layer is dark grayish brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 14 inches thick. The substratum is mostly light brownish gray and grayish brown loam to a depth of 60 inches.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Vida soil is deep and well drained. It formed in glacial till. Typically, the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is dark grayish brown and brown clay loam 10 inches thick. The

substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 40 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The soils in this complex are used for dryland crops and as rangeland. The main dryland crops are wheat and barley.

Wind erosion is the main limitation to the use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

The soils in this complex are suited to use as rangeland. The potential plant community on the Williams and Vida soils consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of plants such as Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, and shrubby cinquefoil. Weedy plants likely to invade with continued grazing pressure are Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss. The potential plant community produces 2,500 pounds of forage per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

These soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the slow permeability.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

143—Williams-Vida loams, 4 to 8 percent slopes. This complex consists of gently rolling soils on glaciated uplands. The elevation is 2,400 to 3,600 feet. The average annual precipitation is 15 inches, and the average annual temperature is 43 degrees F. The average growing season is 110 days.

The Williams soil makes up about 45 percent of this map unit, and the Vida soil makes up 40 percent. Included with these soils in mapping are small areas of Bearpaw, Nishon, Dimmick, and Zahill soils. These soils make up about 15 percent of this unit. The level to nearly level Dimmick and Nishon soils are in undrained basins. The Zahill soil is on ridges.

The Williams soil is deep and well drained. It formed in glacial till on the lower part of slopes and in areas between knolls and ridges. Typically, the surface layer is dark grayish brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 14 inches thick. The substratum is mostly light brownish gray and grayish brown loam to a depth of 60 inches.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The Vida soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is dark grayish brown and brown clay loam 10 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is medium. Wind and water erosion are moderate hazards.

The soils in this complex are used for dryland crops and as rangeland. The main dryland crops are wheat and barley.

Wind and water erosion are the main limitations to the use of these soils for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

These soils are suited to use as rangeland. The potential plant community on the Williams and Vida soils consists mainly of rough fescue, bluebunch wheatgrass, and green needlegrass. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of plants such as Idaho fescue, needleandthread, prairie junegrass, western wheatgrass, fringed sagewort, blue grama, common snowberry, and big sagebrush. Weedy plants likely to invade with continued grazing pressure are Kentucky bluegrass, timothy, annual grasses, Hood phlox, pussytoes, and clubmoss.

Forage production is 2,500 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years.

The potential heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished, and thus forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The soils can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderately slow permeability limits these soils for most urban uses. Septic tank absorption fields require special design because of the limitations imposed by permeability.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

144—Windham cobbly loam, 15 to 45 percent slopes. This is a deep, well drained, moderately steep to steep soil. It formed in alluvium on terraces and fans on uplands. The elevation is 3,200 to 4,500 feet. Slopes are mainly medium in length. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer is dark grayish brown cobbly loam 6 inches thick. The substratum is pale brown, very gravelly loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is about 60 inches. The average wetting depth of the soil under native vegetation is 30 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. This soil has a large number of coarse fragments; consequently, it is droughty.

Small areas of Judith and Whitecow soils are included with this soil in mapping.

This soil is very poorly suited to cultivated crops because of steep slopes, droughtiness, and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue and bluebunch wheatgrass and an increase of plants such as western wheatgrass, fringed sagewort, needleandthread, blue grama, prairie junegrass, threadleaf sedge, clubmoss, annual grasses, Hood phlox, and pussytoes. Forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

This soil is not suitable for windbreaks because the slopes are more than 15 percent.

The moderately steep to steep slopes limit this soil for most urban uses.

Capability subclass VIe, dryland; Thin Hilly range site, 15- to 19-inch precipitation zone.

145—Work clay loam, 0 to 4 percent slopes. This is a deep, well drained, nearly level to gently sloping soil that formed in alluvium on terraces and fans on uplands. The elevation is 2,800 to 4,000 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is grayish brown clay loam 6 inches thick. The subsoil is dark brown clay and grayish brown clay loam 13 inches thick. The upper part of the substratum is grayish brown clay loam 10 inches thick. The lower part, to a depth of 60 inches, is pale brown gravelly clay loam.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Small areas of Gerdrum, Martinsdale, and Shaak soils are included with this soil in mapping. The Gerdrum soil is moderately affected by sodium. It is in small, sparsely vegetated depressions.

The Work soil is used for dryland and irrigated crops. It is also used as rangeland. The main dryland crops are wheat, oats, and barley. The main irrigated crops are wheat, barley, and alfalfa for hay.

Wind erosion is the main limitation to the use of this soil for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, shrubby cinquefoil, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes. Forage production is 2,000 pounds per acre in favorable years and 1,000 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue

spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderately slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability.

Capability subclass IIIe, dryland, and IIIe, irrigated; Silty range site, 15- to 19-inch precipitation zone.

146—Work clay loam, 4 to 8 percent slopes. This is a deep, well drained, moderately sloping soil that formed in alluvium on terraces and fans on uplands. The elevation is 2,800 to 4,000 feet. Slopes are mainly medium in length. The average annual precipitation is 14 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer of this soil is grayish brown clay loam 6 inches thick. The subsoil is dark brown clay and grayish brown clay loam 13 inches thick. The upper part of the substratum is grayish brown clay loam 10 inches thick. The lower part, to a depth of 60 inches, is pale brown gravelly clay loam.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 34 inches. Runoff is moderate. Wind and water erosion are moderate hazards.

Small areas of Gerdrum, Martinsdale, and Shaak soils are included with this soil in mapping. The Gerdrum soil is moderately affected by sodium. It is in small, sparsely vegetated depressions.

The Work soil is used mainly as rangeland. It is also used for dryland crops, mainly wheat, oats, and barley.

Wind and water erosion are the main limitations to the use of this soil for cultivated crops. Stripcropping, tall-grass barriers, field windbreaks, minimum tillage, tillage that utilizes crop residue, contour stripcropping, and grassed waterways can effectively control wind and water erosion.

This soil is suited to use as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, green needlegrass, and Idaho fescue. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue, bluebunch wheatgrass, and green needlegrass and an increase of plants such as Idaho fescue, needleandthread, western wheatgrass, fringed sagewort, common snowberry, shrubby cinquefoil, Kentucky bluegrass, timothy, annual grasses, Hood phlox, and pussytoes.

Forage production is 2,000 pounds per acre in favorable years and 1,000 pounds per acre in unfavorable years.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, and Rocky Mountain juniper. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The moderately slow permeability limits this soil for most urban uses. Septic tank absorption fields require special design because of the moderately slow permeability.

Capability subclass IIIe, dryland; Silty range site, 15- to 19-inch precipitation zone.

147—Yamac loam, 2 to 4 percent slopes. This is a deep, well drained, gently sloping soil on fans, foot slopes, and terraces on uplands. It formed in alluvium. The elevation is 2,300 to 3,600 feet. Slopes are mainly medium in length. The average annual precipitation is 13 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

Typically, the surface layer of this soil is grayish brown loam 4 inches thick. The substratum is light brownish gray loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

Small areas of Delpoint soil and Havre soil are included with this soil in mapping. The Delpoint soil is undulating and is moderately deep. It is on the upper part of slopes. The Havre soil is in narrow drainageways.

The Yamac soil is used for dryland crops and as rangeland. The main dryland crops are wheat, barley, and oats.

Wind erosion is the main limitation to use of this soil for cultivated crops, but stripcropping, tall-grass barriers, field windbreaks, minimum tillage, and tillage that utilizes crop residue can effectively control wind erosion.

This Yamac soil is suited to use as rangeland. The potential plant community consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass and green needlegrass and an increase of needleandthread, blue grama, and fringed sagewort. Annual grasses, broom snakeweed, and clubmoss are likely to invade. Forage production is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years.

Clubmoss is very competitive, and its potential heavy infestation is a serious problem. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

This soil is suited to the use of machinery in preparing a seedbed and in planting.

This soil can be used for windbreaks. Suitable trees include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

This soil is suited to most urban uses.

Capability subclass IIIe, dryland; Silty range site, 10- to 14-inch precipitation zone.

148—Yamac-Benz loams, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping soils on fans and terraces in valleys and on uplands. The elevation is 2,300 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Yamac soil makes up about 50 percent of this map unit, and the Benz soil makes up 35 percent. Included with these soils in mapping are small areas of Cabbart, Delpoint, Havre, and Harlem soils. These soils make up about 15 percent of the map unit. The Cabbart soil is on knolls and ridges. Havre and Harlem soils are in narrow drainageways.

The Yamac soil is deep and well drained. It formed in alluvium on the upper part of slopes. Typically, the surface layer is grayish brown loam 4 inches thick. The subsoil is light olive brown loam 7 inches thick. The substratum is light brownish gray loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 36 inches. Runoff is slow. Wind erosion is a moderate hazard, and water erosion is a slight hazard.

The Benz soil is deep and well drained. It formed in alluvium in sparsely vegetated areas. Typically, the surface layer is dark grayish brown loam 3 inches thick. The substratum, to a depth of 13 inches, is grayish brown loam; below that, to a depth of 60 inches, it is mainly grayish brown loam and clay loam stratified with thin lenses of fine sandy loam.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 25 inches. Runoff is medium. Wind and water erosion are moderate hazards. This soil is strongly affected by sodium and is subject to surface crusting; consequently, seedling emergence is impeded and crop yields are reduced.

In some small areas, the soils in this complex are used for dryland crops, mainly wheat and barley. The Benz soil is very poorly suited to cultivated crops.

The soils in this complex are suited to use as rangeland and are used mainly as rangeland. Most of the forage is produced on the Yamac soil. The potential plant community on the Yamac soil consists mainly of western wheatgrass, green needlegrass, needleandthread, winterfat, silver sagebrush, and forbs. The potential plant community on the Benz soil consists of western wheatgrass, prairie junegrass, Sandberg bluegrass, inland saltgrass, Nuttall saltbush, greasewood, green needlegrass, and forbs. Continued excessive grazing results in a decrease of desirable plants such as western wheatgrass, Nuttall saltbush, and green needlegrass and an increase of needleandthread, blue grama, threadleaf sedge, fringed sagewort, forbs, annual grasses, clubmoss, broom snakeweed, and foxtail barley.

Forage production on the Yamac soil is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. Forage production on the Benz soil is 400 pounds per acre in favorable years and 200 pounds per acre in unfavorable years.

The possibility of heavy infestation by clubmoss is a serious problem. Clubmoss is very competitive. It forms a spongelike mat that absorbs much of the precipitation before it can enter the soil. Clubmoss can be effectively removed by mechanical means. Its removal increases water infiltration, reduces plant competition, and allows desirable native plants to become reestablished; thus, forage production increases.

These soils are suited to the use of machinery in preparing a seedbed and in planting.

The Yamac soil can be used for windbreaks. The Benz soil is not suitable for windbreaks because it is strongly affected by sodium. Suitable trees for the Yamac soil include Russian-olive, green ash, Siberian elm, white and golden willows, ponderosa pine, Scotch pine, blue spruce, Rocky Mountain juniper, and Douglas-fir. Suitable shrubs include Siberian peashrub, common chokecherry, American plum, silver buffaloberry, and lilac.

The slow permeability of the Benz soil limits these soils for most urban uses. Septic tank absorption fields on the Benz soil require special design because of the slow permeability.

Capability subclass IVe, dryland. Yamac soil is in Silty range site, 10- to 14-inch precipitation zone; Benz soil is in Saline Upland range site, 10- to 14-inch precipitation zone.

149—Yamac-Wabek association, moderately steep. This association consists of deep, well drained soils on uplands. The elevation is 2,800 to 3,600 feet. The average annual precipitation is 12 inches, and the average annual temperature is 43 degrees F. The average growing season is 115 days.

The Yamac soil makes up about 60 percent of this association, and the Wabek soil makes up 25 percent. Included with these soils in mapping are small areas of Beaverell, Delpoint, and Lisam soils. These soils make up about 15 percent of the association.

The Yamac soil formed in alluvium on the lower part of slopes. Typically, the surface layer is grayish brown loam

4 inches thick. The subsoil is light olive brown loam 7 inches thick. The substratum is light brownish gray loam to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 30 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Wabek soil formed in alluvium in the higher lying areas on the edge of terraces and the top of ridges. Typically, the surface layer is dark grayish brown and dark brown gravelly loam 8 inches thick. The upper part of the substratum is light brownish gray, very gravelly loamy coarse sand 7 inches thick. The lower part is grayish brown very gravelly coarse sand to a depth of 60 inches or more.

Permeability is very rapid, and the available water capacity is very low. The effective rooting depth is about 20 inches. The average annual wetting depth of the soil under native vegetation is 20 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard. Depth to very gravelly coarse sand is 7 to 20 inches. This soil is very droughty.

The soils in this association are not suited to cultivated crops because of moderately steep slopes and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

These soils are suited to use as rangeland and are used as rangeland. Most of the forage is produced on the Yamac soil. The potential plant community on the Yamac soil consists mainly of western wheatgrass, bluebunch wheatgrass, needleandthread, green needlegrass, winterfat, prairie sandreed, and forbs. The potential plant community on the Wabek soil consists of needleandthread, western wheatgrass, and prairie sandreed. Forbs and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as bluebunch wheatgrass, prairie sandreed, and western wheatgrass and an increase of needleandthread, threadleaf sedge, blue grama, prairie junegrass, fringed sagewort, annual grasses, red threeawn, and broom snakeweed.

Forage production on the Yamac soil is 1,500 pounds per acre in favorable years and 800 pounds per acre in unfavorable years. Forage production on the Wabek soil is 900 pounds per acre in favorable years and 500 pounds per acre in unfavorable years.

The soils in this association are not suited to windbreaks because the slopes are more than 15 percent.

The moderately steep slopes limit these soils for most urban uses.

Capability subclass VIe, dryland. Yamac soil is in Silty range site, 10- to 14-inch precipitation zone; Wabek soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone.

150—Zahill clay loam, 25 to 45 percent slopes. This is a deep, well drained soil that formed in glacial till on glaciated uplands. The elevation is 2,400 to 4,000 feet. Slopes are mainly medium in length. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 32 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

Small areas of Cabba, Norbert, and Vida soils are included with this soil in mapping.

The Zahill soil is not suited to use as cropland because of steep slopes and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

This soil is suited to use as rangeland and is used as rangeland. The potential plant community consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue and bluebunch wheatgrass and an increase of plants such as Idaho fescue, western wheatgrass, needleandthread, blue grama, prairie junegrass, threadleaf sedge, annual grasses, Hood phlox, and pussytoes. Forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

This soil is not suitable for windbreaks because of slope.

Steep slopes limit these soils for most urban uses.

Capability subclass VIe, dryland; Thin Hilly range site, 15- to 19-inch precipitation zone.

151—Zahill-Vida clay loams, 15 to 35 percent slopes. This complex consists of hilly to steep Zahill soil and hilly Vida soil on glaciated uplands. The elevation is 2,400 to 3,800 feet. The average annual precipitation is 15 inches, and the average annual temperature is 42 degrees F. The average growing season is 110 days.

The Zahill soil makes up about 50 percent of this map unit, and the Vida soil makes up 40 percent. Included with these soils in mapping are small areas of Bearpaw, Cabbart, and Lisam soils. These soils make up about 10 percent of the map unit.

The Zahill soil is deep and well drained. It formed in glacial till on knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is grayish brown clay loam. The substratum is grayish brown clay loam to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches.

The average annual wetting depth of the soil under native vegetation is 32 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The Vida soil is deep and well drained. It formed in glacial till on slopes below knolls and ridges. Typically, the surface layer, where it is mixed to a depth of about 7 inches, is dark grayish brown clay loam. The subsoil is mostly brown clay loam 7 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is 32 inches. Runoff is rapid. Wind erosion is a moderate hazard, and water erosion is a severe hazard.

The soils in this complex are not suited to cultivated crops because of the slope and the severe hazard of water erosion. A permanent and adequately maintained cover of natural vegetation helps to control water erosion.

These soils are suited to use as rangeland and are used as rangeland. The potential plant community on these soils consists mainly of rough fescue, bluebunch wheatgrass, and little bluestem. Sedges, forbs, and some woody plants are decreasers. Continued excessive grazing results in a decrease of desirable plants such as rough fescue and bluebunch wheatgrass and an increase of Idaho fescue, needleandthread, blue grama, prairie junegrass, threadleaf sedge, annual grasses, Hood phlox, and pussytoes. Forage production is 1,500 pounds per acre in favorable years and 900 pounds per acre in unfavorable years.

The soils in this complex are not suited to windbreaks because of slope.

The steep slopes limit these soils for most urban uses.

Capability subclass VIe, dryland; Thin Hilly range site, 15- to 19-inch precipitation 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 avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops

E. Lee Jones, resource conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and of hay 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 "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

There are about 550,000 acres of cropland in this survey area. The cropland includes about 470,000 acres of dryfarmed land and 80,000 acres of irrigated land. The acreage of the dryfarmed land has increased in recent years, particularly on the Fort Belknap Indian Reservation, because of the higher return per acre from cultivated crops than from range.

The main dryland crops are spring wheat, winter wheat, and barley. Oats and hay are also seeded. The main management needs on dryfarmed land are conserving moisture, controlling weeds, maintaining or improving fertility, controlling soil loss from wind and water erosion, and controlling or preventing saline seep.

Generally, dryfarming methods include alternating strips of crop and fallow for production of small grains. Leaving crop residue on the surface, leaving the surface cloddy or rough, establishing strips of proper width, using chemicals to control insects and weeds, using proper levels of fertilization, and timely use of tillage equipment generally can maintain or improve yields.

The main irrigated crops are alfalfa, mixed legume-grass hay, spring wheat, and barley. Corn for silage, oats, and sugar beets are also seeded. The main management needs on irrigated cropland are conserving irrigation water, improving drainage, controlling weeds, and preventing or reducing salinity and alkalinity. Nearly two-thirds of the irrigated land in the Milk River Valley has moderate or high levels of salinity or alkalinity. Overirrigation, lack of adequate drainage, and slowly permeable soils have been the major causes of the salinity problem.

Some dryfarmed land is used for crested wheatgrass for early spring grazing. Some of the crested wheatgrass was seeded in the late 1930's on abandoned cropland, but, more recently, fields are being established as part of a planned ranch operation.

The potential of the soils in the survey area for increased production of food is good. More than 150,000 acres of potentially good dry cropland is now used as range. An additional 20,000 acres of cropland could be irrigated under existing irrigation systems if an adequate water supply were available. In addition to the reserve

production capacity of the rangeland, food production can be increased on the cultivated land if the latest crop production technology is applied.

soil erosion

Soil erosion is a major problem on most of the cultivated land and on some of the rangeland in the survey area. Loss of the surface layer through erosion affects soil productivity, soil tilth, available water capacity, rooting depth, and the sediment load in streams. Some cultivated soils, such as the Thoeny and Shaak soils, have a loam surface layer and a dense clayey subsoil. Loss of the surface layer through erosion exposes the clayey subsoil and makes the preparation of a good seedbed and tillage difficult. Loss of the surface layer through erosion on soils underlain by bedrock or gravel and sand, such as the Belain and Attewan soils, reduces the rooting depth and the available water capacity.

Generally, wind erosion is a hazard on all cultivated soils. Sandy soils, such as Chinook and Lihen soils, are highly susceptible to soil loss by wind. These sandy soils require narrow field strips and, in some places, a permanent cover to protect them from wind erosion. A loamy or clayey surface layer in areas that are block-farmed or where wide strips are used is very susceptible to wind erosion. Overgrazed rangeland is also susceptible to wind erosion.

Runoff causes erosion on most of the cropland and on some of the rangeland, particularly on steep slopes, long slopes, and lower lying areas below steeper slopes. Sediment from water erosion pollutes streams and rivers and lowers the quality of water for municipal uses, recreation, and fish and wildlife.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. Because eroded soils are less productive, a cropping system that keeps vegetative cover on the soil for an extended period reduces soil erosion and maintains the productive capacity of the soil. On livestock farms, good forage and grass cover on sloping land reduces soil loss to an acceptable level.

Leaving crop residue on the surface helps to reduce erosion and to increase water infiltration. Also helpful are leaving the surface rough, establishing wind strips of proper width, establishing grassed waterways, farming on the contour, contour tillage or contour stripcropping, and planting field windbreaks or grass wind barriers. Contour tillage and contour stripcropping are not practical on undulating or rolling glacial soils, such as Kevin and Vida soils, because the slopes are short and irregular.

Information about erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service.

saline seep

Saline seep is a serious potential hazard in the survey area. The soils on about 500 to 600 acres are too wet and saline to farm. These areas prevent or hinder farming on several thousand acres of surrounding cropland (*3*). The saline seeps are increasing in size at a rate of about 10 percent per year. The size of the areas ranges from less than one-tenth acre to more than 40 acres.

The saline seep occurs mostly on cultivated soils on uplands where sedimentary beds underlie the surface at a relatively shallow depth. The alternate crop-fallow farming system, which is commonly used, allows precipitation not used by plants to pass through the soil in the recharge area. This water dissolves salts, becomes salty, and collects on an impermeable underlying layer of shale or rock. The salty water then flows laterally along the beds. It surfaces as a low-volume saline spring or saline seep.

Saline seep can be controlled by reseeding the contributing or recharge area to permanent vegetation. A deep-rooted crop such as alfalfa will effectively reduce the water table. A continuous cropping system or a 2-year crop, 1-year fallow cropping system prevents or controls saline seep and also increases overall crop production.

soil drainage

Soil drainage is good in the survey area except for part of the Milk River Valley, small areas along some streams and drainageways, and "potholes" on the glaciated uplands.

About one-half of the irrigated land in the Milk River Valley needs improved drainage. Lack of adequate slope and drainage outlets, slowly permeable soils, and excess use of water for irrigation have caused the water table and soil salinity to build up.

There are about 12,000 acres of somewhat poorly drained soils and poorly drained soils in the "potholes" on the glaciated plains. These are the Dimmick and Nishon soils; they receive surface water from surrounding areas. Drainage of these soils generally is not practical because of the terrain and the lack of natural drainageways. In cultivated areas the somewhat poorly drained soils can be planted to grain crops in most years; on the poorly drained soils, however, seeding of crops is prevented or delayed more than half the time. These soils are very productive of forage, and the wetter areas are useful as habitat for wildlife.

Soils in more than 15,000 acres along small streams and drainageways are subject to wetness to some degree. The drainage is a problem mainly in cultivated areas. These areas are more productive of forage than the adjacent rangeland.

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 crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, 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.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no ercsion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed soil map units."

The soils in this survey area have been grouped into capability subclasses but have not been grouped into capability units.

rangeland

Joseph A. Wirak, range conservationist, Soil Conservation Service, prepared this section.

About 79 percent of the land in the survey area is rangeland or grazable woodland. Livestock consists mostly of cattle, but in the 1920's, 1930's, and early 1940's there were large numbers of sheep and horses.

Cow-calf is the major livestock type of operation. The average size of ranches in the survey area, excluding the Fort Belknap Indian Reservation, is 5,500 acres.

On some ranches only enough land is cultivated to produce hay for the unit. On other ranches, grain production is combined with raising livestock. Only a few ranches have commercial feedlots. Most livestock grazing is on native rangeland, but some ranchers use fields of crested wheatgrass as early spring pasture. In the Milk River valley and along the many creeks and streams in the area, irrigated hay and cropland are common.

The native vegetation in many parts of the survey area has been changed by prolonged heavy grazing. Desirable grasses and forbs, such as bluebunch wheatgrass, rough fescue, green needlegrass, winterfat, and western wheatgrass, have been replaced by needleandthread, blue grama, shrubby cinquefoil, fringed sagewort, cactus, and clubmoss. Forage production, consequently, has been reduced.

Complete seedbed preparation and seeding the desirable adapted introduced species or the native grasses and legumes can increase forage production. Plantings of introduced species should be fenced separately from native range and managed as a separate unit. If a grazing system or management plan is applied following renovation or seeding, the rangeland will maintain production near its potential.

In the Bearpaw Mountains and Little Rocky Mountains where slopes generally are too steep to permit reseeding or renovation, the range condition can be improved with rest or a deferred-rotation grazing system and proper stocking. Cross-fencing and stockwater developments can help distribute livestock to relieve pressure in overgrazed areas and to make use of undergrazed areas.

Livestock do not fully utilize forage on much of the sandstone and shale uplands in the southern part of the survey area. Good watering areas for livestock are difficult to develop. Springs, suitable dam sites, or water-bearing aquifers for wells are scarce. Proper placement of rain traps or catchment basins and of salt improves livestock distribution and forage utilization.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

woodland management and productivity

Harold E. Hunter, woodland conservationist, Soil Conservation Service, prepared this section.

There are about 80,000 acres of forest land in the survey area, but only about 18,000 acres are presently considered potential commercial woodland. The largest areas of forest land are on the shale and sandstone uplands and on the Little Rocky Mountains and Bearpaw Mountains. Most forests have a wide range in stand density.

The main types of forest cover generally correspond to geographical areas. The principal trees in the Bearpaw Mountains are ponderosa pine; there are smaller numbers of Rocky Mountain juniper, quaking aspen, and Douglas-fir. The principal trees on the shale and sandstone uplands in the southern half of the survey area are ponderosa pine; there are smaller numbers of Rocky Mountain juniper, limber pine, and Douglas-fir. The principal trees on the stream or river bottoms are plains cottonwood. The variety of trees is wider in the Little Rocky Mountains. There is mostly ponderosa pine on the south- and west-facing slopes and quaking aspen, paper birch, lodgepole pine, and Douglas-fir on the north- and east-facing slopes.

The ponderosa pine in the southeastern two-thirds of the Bearpaw Mountains presently has low commercial value, except for posts and poles, because of the slow rate of growth and the poor quality of the wood. There is, however, an area at the headwaters of Clear and People Creeks that has some stands of Douglas-fir, lodgepole pine, and ponderosa pine that are of commercial quality.

The ponderosa pine on the shale and sandstone uplands generally is not considered to be of commercial value because of the slow rate of growth and the poor quality of the wood. It has value for posts and poles, and some individual trees are suitable for saw logs.

The cottonwood trees along the stream or river bottoms have little value as woodland. The stands, of mixed age and size, are in strips along the channels. These trees are highly suitable for wildlife habitat and for streambank protection.

The Little Rocky Mountains have mixed stands of forest cover because of changes in climate and the different aspects and because the area was burned over in 1936. On the north- and east-facing slopes, the moisture and temperature regimes are favorable for Douglas-fir and lodgepole pine, and on the warmer and

drier south- and west-facing slopes, the regimes are favorable for ponderosa pine. The mature trees that were not burned have good timber value; however, the quantity is limited. The trees reestablished since 1936 generally are too small for saw logs, but stands of lodgepole pine have commercial value for poles and posts.

The greatest potential for woodland production is mainly in the Little Rocky Mountains and part of the Bearpaw Mountains. Reestablishment of ponderosa pine on the south-facing slopes and Douglas-fir on the north-facing slopes in the Little Rocky Mountains has been slow. Management practices such as reseeding of adapted tree species in open areas or in thin forest stands and thinning of trees in dense stands could increase timber production.

All forest areas, regardless of timber production, are valued for other purposes such as watershed protection, livestock grazing, and wildlife habitat. Forests presently considered noncommercial, such as the areas of ponderosa pine on the shale and sandstone uplands, will probably have enough value to be harvested for pulp and chips in the future.

The estimates given in the map unit descriptions for board feet and cubic feet of production are based on the following utilization standards.

The board feet of production for Douglas-fir and ponderosa pine is based on the Scribner rule of trees 11.6 inches or more in diameter at breast height. The board feet of production for lodgepole pine is based on the Scribner rule of trees 10.0 inches or more in diameter at breast height or higher to an 8-inch top.

The total cubic feet of production for Douglas-fir and ponderosa pine is based on all trees 0.6 inch in diameter including stump and tip but not bark. The total cubic feet of production for lodgepole pine is based on all trees larger than 4.5 feet tall from groundline to tip.

woodland understory vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

windbreaks and environmental plantings

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. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 6 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 6, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 6 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 8 and interpretations for dwellings without basements and for local roads and streets in table 7.

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, horseback riding, and bicycling 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

Ronald F. Batchelor, biologist, Soil Conservation Service, prepared this section.

Wildlife is a product of the land. The abundance of a species is directly related to the extent and diversity of its habitat. The relationship of wildlife to soils is better expressed as a soil-vegetation-wildlife relationship, inasmuch as species of wildlife are more readily associated with the plant communities that make up their habitat than with specific soils alone. Productive and well-managed soils generally support or have potential to support a vigorous wildlife population. Together, plants and animals make up natural communities that are governed by many environmental influences of which soil is but a part.

The quality and interspersion of habitat determine the wildlife population level. The suitability of a given habitat for a species of wildlife depends greatly on the nature of plant communities present, while the quantity, quality, and distribution of a habitat is determined by prevailing land use practices and management. These factors are governed to some extent by the soils of the area.

Rangeland, coniferous forests, dry and irrigated farmland, riparian woodland, streams and rivers, and ponds and reservoirs provide a variety of wildlife habitat in the survey area.

Irrigated and dryland farming made possible the successful introduction of the ring-necked pheasant, particularly in the bottom lands along the Milk River and its tributaries. Such success was possible because varied patterns of land use that included small grains, irrigated cropland, and an abundance of annual weeds and perennial shrubs provided both food and cover. In recent years, more intensive "clean farming," the loss of brushy fence rows and densely vegetated ditchbanks, and fewer oddly shaped areas have reduced the available habitat and caused a decline in the number of pheasants.

Land management practices that are beneficial to pheasants include proper grazing, protection of woody cover from burning or eradication, and the retention of stubble and waste grain in winter through the elimination of fall tillage. Woody plantings in the form of shelterbelts or windbreaks are beneficial to pheasants and other game and nongame animals.

The Harlem-Havre-Lardell map unit includes the major part of the Milk River Valley, and it provides habitat for ring-necked pheasant in the form of irrigated and dry cropland, brushy ditchbanks, and fence rows. The Vida-Bearpaw-Zahill and Kevin-Scobey-Hillon map units provide good pheasant habitat in the form of grainfields, shelterbelts, and brushy drainageways.

Sharp-tailed grouse inhabit much of the uplands where grainfields and brushy thickets of fruit-bearing shrubs, including chokecherry, Woods rose, common snowberry, skunkbush sumac, and silver buffaloberry provide excellent habitat. When grouse populations are high, the grouse extend their range into drainageways surrounded by small grain crops. When populations are low, they inhabit mostly drainageways where stands of trees and shrubs are interspersed with grassland.

The gray, or Hungarian, partridge is also associated with cropland-grassland areas. Like that of sharp-tailed grouse, the gray partridge population fluctuates, building to a high followed by a decline. Such population fluctuations result from changes in available habitat, weather variations, and possibly disease.

Land management practices beneficial to sharp-tailed grouse and gray partridge include proper grazing use of rangelands to insure that sufficient plant residue is retained as cover for nesting, roosting, and brood rearing; the protection of brushy draws and fence rows; and the establishment of shelterbelts.

The Kevin-Scobey-Hillon, Telstad-Joplin, Vida-Bearpaw-Zahill, Hillon-Lisam-Cabbart, and Hedoes-Belain-Castner map units support plant communities with good potential for sharp-tailed grouse and gray partridge. Within these units, grainfields, shelterbelts and windbreaks, brushy drainageways, and a mixed plant community of trees, shrubs, and grasslands provide suitable habitat for these prairie species.

Sage grouse inhabit sagebrush-covered rangelands throughout the area. Optimum sage grouse habitat is characterized by communities of big sagebrush and silver sagebrush with a variety of forbs and grasses and the environmental factors associated with such plant communities.

The Bearpaw-Vida-Elloam, Lisam-Dilts-Bascovy, and Lisam-Dilts-Rock outcrop, shale, map units provide good habitat for sage grouse in the form of brushy drainageways and sagebrush-covered rangelands.

The blue grouse, a forest-dwelling species, is common throughout the coniferous woodlands of the survey area, especially in the Little Rocky Mountains and the Bearpaw Mountains. The habitat requirements of blue grouse vary with the seasons. They winter at high elevations, then early in spring they descend to semi-open woodland for breeding, nesting, and brood rearing.

Blue grouse are closely associated with the distribution patterns of true firs and Douglas-fir in Montana. The extent and quality of their habitat are largely determined by forest management practices, grazing, and fire. The brushy thickets, stream bottoms, mixed forests, and grazable woodlands of the Hedoes-Belain-Castner and Whitecow-Macmeal-Warneke map units provide suitable habitat for blue grouse populations within the survey area.

Merriam's turkeys have been introduced in the southern part of the Little Rocky Mountains. Suitable habitat is generally restricted to open forests of ponderosa pine in rugged terrain. Turkeys are more numerous in forests that have a vegetative cover of ponderosa pine with grasses, deciduous trees, and shrubs in scattered small openings and in drainageways throughout the forest. The Whitecow-Macmeal-Warneke map unit provides most of the suitable habitat for Merriam's turkey within the survey area.

Pronghorn antelope inhabit the sagebrush-grassland ranges of the survey area. The potential for maintaining pronghorn herds is largely dependent on the proper management of rangelands. If ranges are overgrazed, competition for food between domestic livestock and pronghorns can be serious. There is little competition on well-managed range. Pronghorns utilize forbs and browse that cattle seldom eat unless forced to do so because of overgrazing.

The Kevin-Scobey-Hillon, Telstad-Joplin, Vida-Bearpaw-Zahill, Bearpaw-Vida-Elloam, Hillon-Lisam-Cabbart, Attewan-Wabek-Beaverell, Martinsdale-Shawmut-Turner, Shaak-Attewan-Work, Barkof-Cabba-Windham, Cabbart-Delpoint, and Lisam-Dilts-Bascovy map units provide most of the suitable habitat for pronghorn antelope.

White-tailed and mule deer are common throughout much of the survey area. White-tailed deer generally inhabit the lowlands and valleys of the Missouri and Milk Rivers, stream bottoms, and lower foothills adjacent to farmlands. Mule deer inhabit wooded areas, broken rangeland, the Missouri breaks, and brushy watercourses. The Harlem-Havre-Lardell, Hedoes-Belain-Castner, and Whitecow-Macmeal-Warneke map units provide suitable habitat for white-tailed deer.

The Kevin-Scobey-Hillon, Vida-Bearpaw-Zahill, Hillon-Lisam-Cabbart, and Hedoes-Belain-Castner map units provide habitat for mule deer.

A small population of Rocky Mountain elk inhabits the Missouri breaks in the southern part of the survey area. Habitat for these elk is generally confined to the rugged breaks and canyons. Elk prefer native bunchgrass ranges, but they are adaptable and can frequently be found in adjacent woodlands and canyons. The Hedoes-Belain-Castner and Whitecow-Macmeal-Warneke map units contain the main areas of suitable elk habitat within the survey area.

Many ponds and reservoirs throughout the survey area provide suitable habitat for waterfowl during spring and fall migrations as well as during the nesting seasons.

On the Vida-Bearpaw-Zahill and Kevin-Scobey-Hillon map units there are many potholes, reservoirs, and stockwater ponds that provide suitable habitat for ducks, geese, and a variety of shore and marsh birds.

Beaver, raccoon, and mink inhabit areas along the major rivers and streams. Cottontail rabbits, badger, ground squirrels, coyotes, jackrabbits, and other small mammals are common in most of the survey area.

Populations of game and nongame species can be increased through application of conservation practices that improve the habitat. These include the development of oddly or irregularly shaped areas in and adjacent to farmland, protection of these areas from fire or grazing, and establishment of woody vegetation to provide winter cover. Wildlife habitat can also be improved by proper grazing use, planned grazing systems, stripcropping, field windbreaks, and pond construction.

engineering

Wayne E. Otto, area engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of of specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were

not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, 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 7 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. 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 the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock 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, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 8 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 8 also shows the suitability of the soils for use as daily cover for landfills. 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 effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 8 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, 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. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 8 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type 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 soil blowing.

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 9 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* . The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil

layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with 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, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 10 gives information on the soil properties and site features that affect water management. It gives for each soil the restrictive features that affect pond reservoir areas; embankments, dikes, and levees; drainage; irrigation; terraces and diversions; and grassed waterways.

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. A rating of *favorable* means that soil properties and site features are generally favorable and limitations are minor and easily overcome.

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.

Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, 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 potential 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.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

This publication does not contain engineering test data, but some tests were made by the State Highway Commission of Montana in cooperation with the Federal Highway Administration, Department of Transportation. Data from those tests were considered in estimating the engineering index properties in table 11.

engineering index properties

Table 11 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. 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 under "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 a soil contains particles coarser than sand, 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 (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an 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 rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 12 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

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 soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

soil and water features

Table 13 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 13 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 13 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 13.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The kind of bedrock and its hardness as related to ease of excavation is also given. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.