United States
Department of
Agriculture

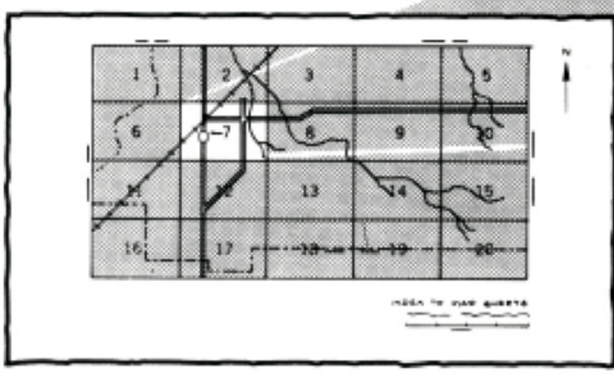
Soil
Conservation
Service

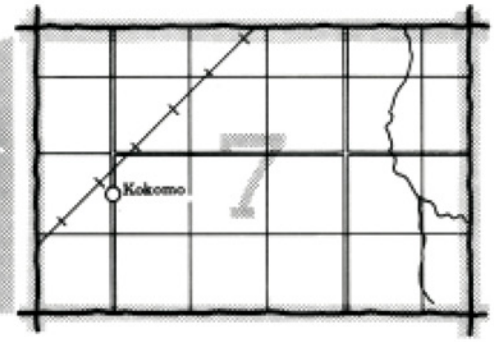
In cooperation with
Oklahoma Agricultural
Experiment Station

Soil Survey of Payne County, Oklahoma

HOW TO USE

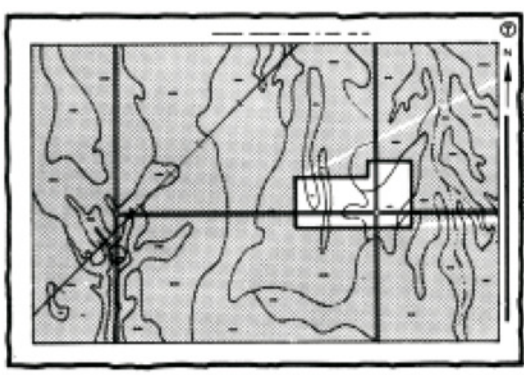
1. Locate your area of interest on the "Index to Map Sheets"

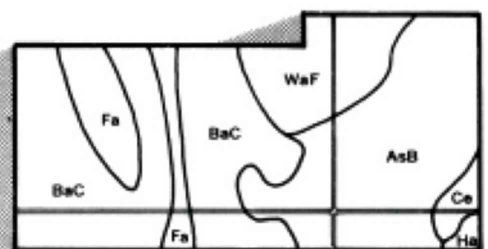




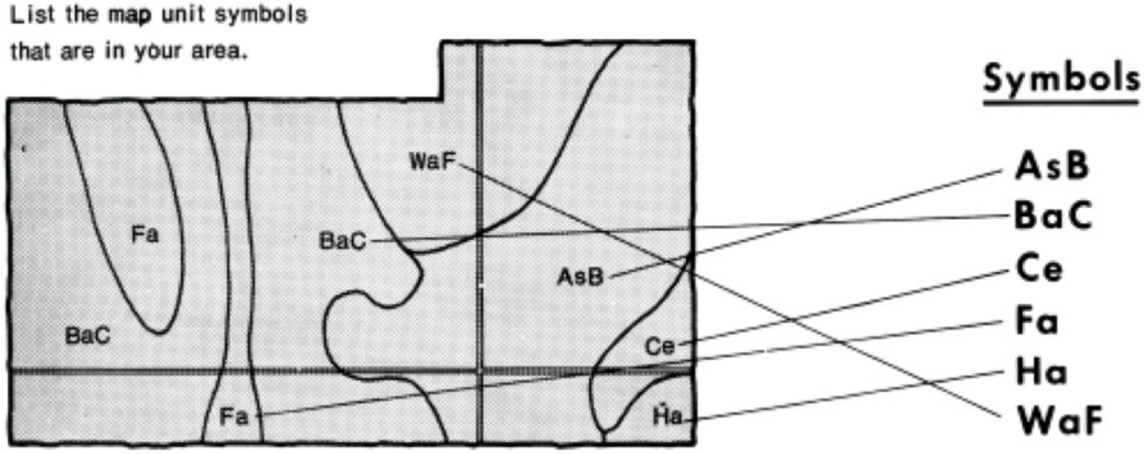
2. Note the number of the map sheet and turn to that sheet.

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



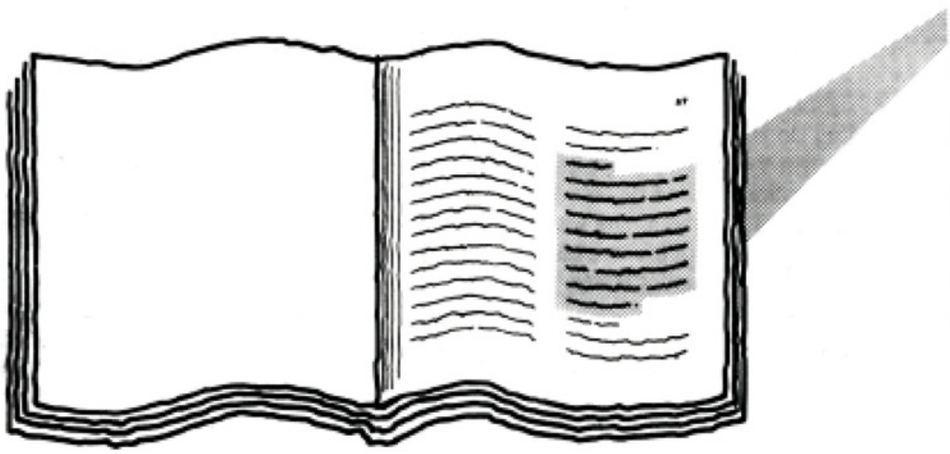
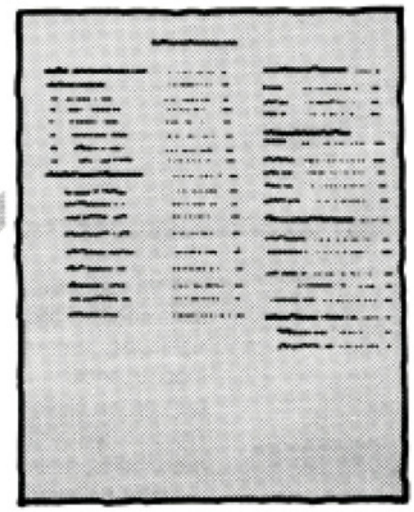


4. List the map unit symbols that are in your area.

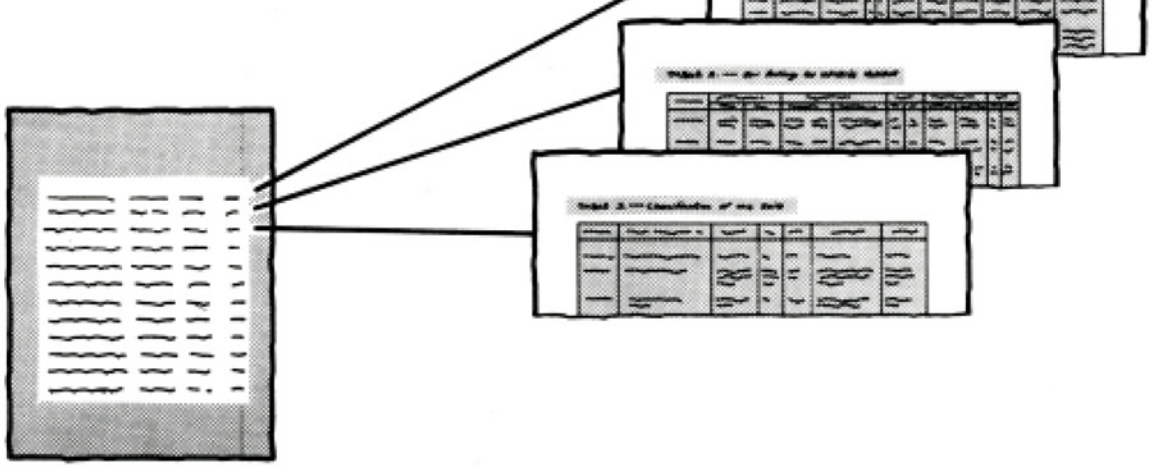


THIS SOIL SURVEY

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

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

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

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

Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This soil survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Payne County Conservation District.

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

Cover: The Oklahoma State University Agronomy Farm is along Stillwater Creek in Payne County. Area of the Pulaski-Easpur-Ashport general soil map unit. Oklahoma State University campus in background.

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Soil Series

Issued April 1987

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Payne County. 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.

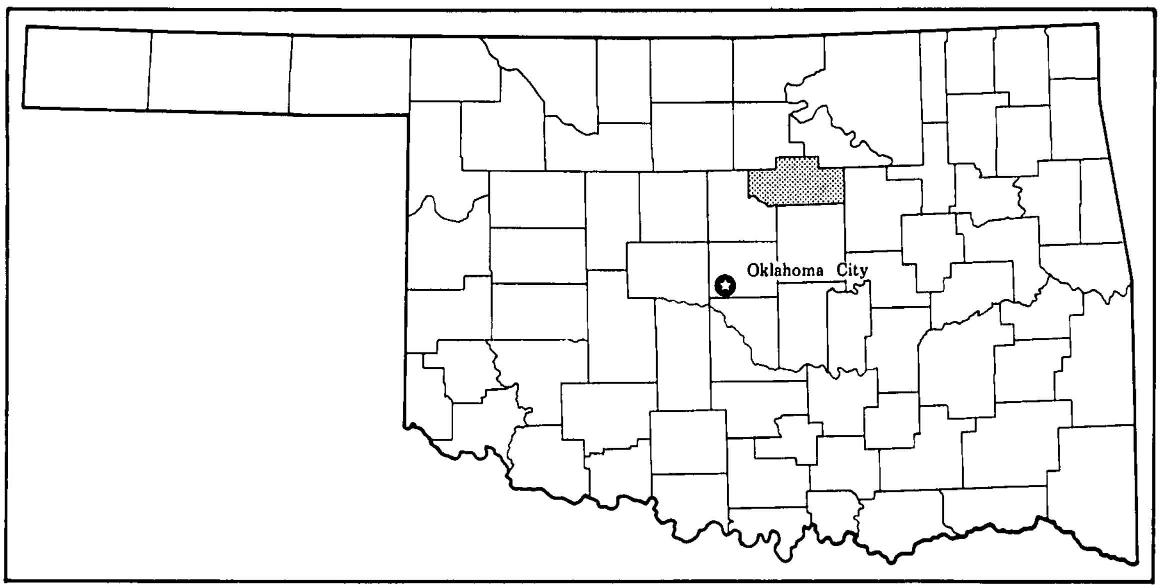
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use 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.

Roland R. Willis

Roland R. Willis
State Conservationist
Soil Conservation Service



Location of Payne County in Oklahoma.

Soil Survey of Payne County, Oklahoma

By Jim Henley, R. Dwaine Gelnar, and Richard E. Mayhugh,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the Oklahoma Agricultural Experiment Station

PAYNE COUNTY is in north-central Oklahoma and has an area of about 448,000 acres, or 700 square miles. Its population is about 64,500. Stillwater, the county seat, is in the central part of the county and has a population of 38,268. Lake Carl Blackwell and other bodies of water larger than 40 acres make up about 3,840 acres. Payne County is bordered on the north by Noble and Pawnee Counties, on the east by Creek County, on the west by Logan County, and on the south by Logan and Lincoln Counties.

General Nature of the County

Settlement and Development

Payne County was originally part of the Creek Nation and the Cherokee Outlet. The first permanent settlement took place in 1889, when the southern part of the county was opened for homesteading. The part included in the Cherokee Outlet was opened for settlement in 1893. The early settlers came largely from Kansas, Missouri, Arkansas, Texas, and Iowa.

Prairie hay and livestock were the main products of the early settlers. By the early 1900's corn was the leading crop, followed by cotton, hay, kafir, oats, and wheat. The extensive row cropping of corn and cotton contributed to severe erosion of a large acreage in Payne County.

The discovery of a large oil field near Cushing led to rapid population growth but also created many areas of desolate oil-waste land where early refineries dumped salt water and waste products.

As climate and economics permit, farmers and ranchers are bringing the severely eroded areas of Payne County back into production by smoothing and shaping gullies and planting marginal land to improved pasture plants. Livestock production is now the major land use in Payne County, with approximately 70 percent of the county in pasture and range. About 20 percent is cropland. Wheat is the principal crop, followed by alfalfa, milo, and peanuts.

Transportation and Industry

Payne County is served by a network of federal, state, and interstate highways. U.S. Highway 177 crosses the central part of the county in a north-south direction. The Cimarron Turnpike crosses the northern part of the county in an east-west direction. Interstate Highway 35 and Oklahoma Highway 86 cross the western part of the county in a north-south direction. Oklahoma Highways 18, 99, and 108 cross the eastern part of the county in a north-south direction. Oklahoma Highway 33 crosses the southern part of the county in an east-west direction, and Oklahoma Highway 51 crosses the central part of the county in an east-west direction. There are very few all-weather farm-to-market roads in the rural areas. However, dirt, gravel, and shale roads run on almost all section lines, providing access to state and federal highways and becoming inaccessible only during periods of prolonged wet weather or heavy snowfall. A railroad crosses the eastern part of the county and serves Cushing and Yale. A short spur line also runs north from Stillwater.

Agriculture provides a major part of the income in Payne County. Livestock, small grains, peanuts, and alfalfa make up the bulk of the produce. Horticultural crops, such as fruits, pecans, and vegetables, are a very small part. The livestock is mainly cattle, followed by hogs and horses. Very few sheep or poultry are raised commercially in the county. A large part of the agricultural produce is marketed within the survey area or in adjacent towns.

Stillwater has several large industrial plants. The major industry in the Cushing area is oil and oil products. There is a large refinery in Cushing, and several of the major oil companies have tank farms and large pipelines in the area. There are still several active oil fields in Payne County.

Oklahoma State University at Stillwater, a large land grant college, is an important part of the county's economy.

Relief and Drainage

Payne County is rolling with small, nearly level upland plains. Average elevation is just under 1,000 feet. The major part of the county drains to the east-southeast into the Cimarron River, and a small area drains northeast to the Arkansas River.

The most productive cultivated areas are along the major creeks and the Cimarron River. Sandy soils predominate in the first and second terrace levels along the Cimarron River. Native range is mainly in the western third of the county with smaller areas around Glencoe, Yale, and Ripley.

The bottom lands along the Cimarron River and Stillwater, Wildhorse, Long Branch, and Council Creeks are subject to floods during heavy rainfall. Flood-control projects have been completed on Long Branch Creek and are being implemented on Stillwater Creek.

Underground water can be withdrawn in sufficient quantity for irrigation along the Cimarron River. However, the salt content, with few exceptions, is too high for agricultural use. The area east of Cushing has a very productive water sand. The city of Cushing has several wells in this sand 500 to 600 feet deep. Farmers in these areas have not displayed an interest in irrigation from this source because of the high cost.

Climate

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

Payne County is hot in summer and cool in winter when occasional surges of cold air cause sharp drops in otherwise mild temperatures. Rainfall is uniform throughout the year, reaching a slight peak in spring. Snowfall is infrequent. Annual precipitation is normally adequate for alfalfa, feed grains, and small grains.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Stillwater in the period 1951 to 1978. 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 the average temperature is 39 degrees F, and the average daily minimum temperature is 27 degrees. The lowest temperature on record, which occurred at Stillwater on December 30, 1983, is -9 degrees. In summer the average temperature is 80 degrees, and the average daily maximum temperature is 92 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 113 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 32 inches. Of this, 22 inches, or 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 16 inches. The heaviest 1-day rainfall during the period of record was 7 inches on May 21, 1957. Thunderstorms occur on about 50 days each year, and most occur in summer.

The average seasonal snowfall is 8 inches. The greatest snow depth at any one time during the period of record was 8 inches. On an average of 5 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 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 60 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 14 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally. These storms are local and short, and the pattern of damage is variable and spotty.

Visual Resources

David Thompson, landscape architect, helped to prepare this section.

The appearance of Payne County is an important natural resource, worthy of inventory, evaluation, and management. The visual resource is the definable appearance of landforms, vegetation, bodies of water, and manmade structures. As with any natural resource, landscape is finite and needs proper management for effective conservation.

Each general soil map unit has a distinctive appearance that can be modified by changing the landscape elements or their patterns. In some areas, the visual resource has been extensively changed by agricultural practices or urban expansion. Visual diversity is described and rated in the descriptions of the general soil map units. These descriptions are based on a comparison of landscapes within the county and the patterns created by the basic landscape elements: landform, vegetation, water, and structures.

The patterns of elements are readily visible and the diversity of that landscape can be rated as high, medium, or low. The landscape that has *high* visual diversity has some or all of the following characteristics: variations in landforms, unique plant communities, varied patterns of vegetation, rivers or streams with high clarity, lakes or ponds with diverse shorelines, and manmade structures. In areas of *low* visual diversity, one landscape element may be dominant and can create a uniform appearance with little or no contrast in pattern. Low diversity areas may have some of the following characteristics: landforms with no variety; a plant cover having no variation in type, height, or color; bodies of water with limited visual interest and unvarying shorelines; and structures having little relation to their surroundings.

Any change in landscape elements and patterns will affect the visual resource. A single practice may improve or degrade the visual quality of an area. For example, grading and revegetating an eroded area will improve visual resource quality. A reduction in visual quality can result from neglect of soil behavior. For instance, a sloping area which has soil suitable for woodland may be cleared and planted to row crops. The unprotected soil may erode severely during winter. A severely eroded soil decreases visual quality by producing unsightly bare areas, loss of soil, decrease in water quality by siltation, and damage to other areas by increased runoff.

Knowledge of each soil and of the results of land use changes are necessary to plan effectively. Assistance in resource planning is available from the Soil Conservation Service. Proper consideration of the soil's characteristics, land use, and the visual elements will result in enhancement or preservation of the quality of the area.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

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

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 a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, rangeland, improved pasture, windbreaks, urban uses,* and *wildlife habitat.* Cultivated crops are those grown extensively in the survey area. Rangeland is areas of native grass, and improved pasture is areas of introduced grasses. Windbreaks are areas of native or introduced trees planted to reduce the wind. Urban uses include residential, commerical, and industrial developments. Wildlife habitat is land suitable for crops and native vegetation that provide food and cover for wildlife.

The land area of the general soil map units makes up 99 percent of Payne County. The remaining acreage is large bodies of water.

Deep and Moderately Deep, Moderately Well Drained and Well Drained, Loamy Soils on Uplands

The soils in this group cover about 39 percent of Payne County. They are used mainly for improved pasture and range, but some areas are used for crops.

1. Agra-Coyle

Very gently sloping to gently sloping, moderately well drained and well drained, loamy soils that formed in material weathered primarily from shale or sandstone under prairie vegetation

These soils are on upland ridgetops and side slopes in the eastern part of the county (fig. 1). Slope ranges from 1 to 5 percent.

The gently sloping ridgetops and side slopes in this map unit provide diversity to the landforms. Patterns of vegetation are diverse; land use is mainly tame pasture and native range. There are narrow streams that generally have high clarity and diverse patterns. Structures are generally farmsteads and occasional other residences. The visual diversity of this unit is medium. Most changes to the landscape will be visually insignificant.

This map unit covers about 7 percent of the county. It is about 53 percent Agra soils, 15 percent Coyle soils, and 32 percent minor soils. I01Agra soils are on broad, convex upland ridgetops and side slopes. These soils are deep, very gently sloping to gently sloping, and moderately well drained. Typically, the surface layer is brown and dark brown silt loam. The subsoil is brownish silty clay loam and silty clay that is coarsely mottled in the lower part.

Coyle soils are on convex upland ridgetops and side slopes. These soils are moderately deep, very gently sloping to gently sloping, and well drained. Typically, the surface layer is dark brown loam. The subsoil is brown loam and brown, strong brown, and reddish yellow clay loam. The underlying material is reddish yellow sandstone.

The minor soils in this map unit are Huska, Mulhall, Norge, Seminole, and Steedman soils on uplands and Pulaski and Gowen soils on narrow flood plains.

Areas of this map unit are used mainly for improved pasture or range. Some areas are used for crops. The major management concerns are maintaining soil structure and fertility, controlling weed competition, and controlling soil erosion.

These soils have medium potential for cultivated crops, improved pasture, and windbreaks. Potential is high for rangeland and openland wildlife habitat. Potential for building sites and sanitary facilities ranges from low to high. Shrinking and swelling, very slow permeability, and depth to bedrock are the main limitations.

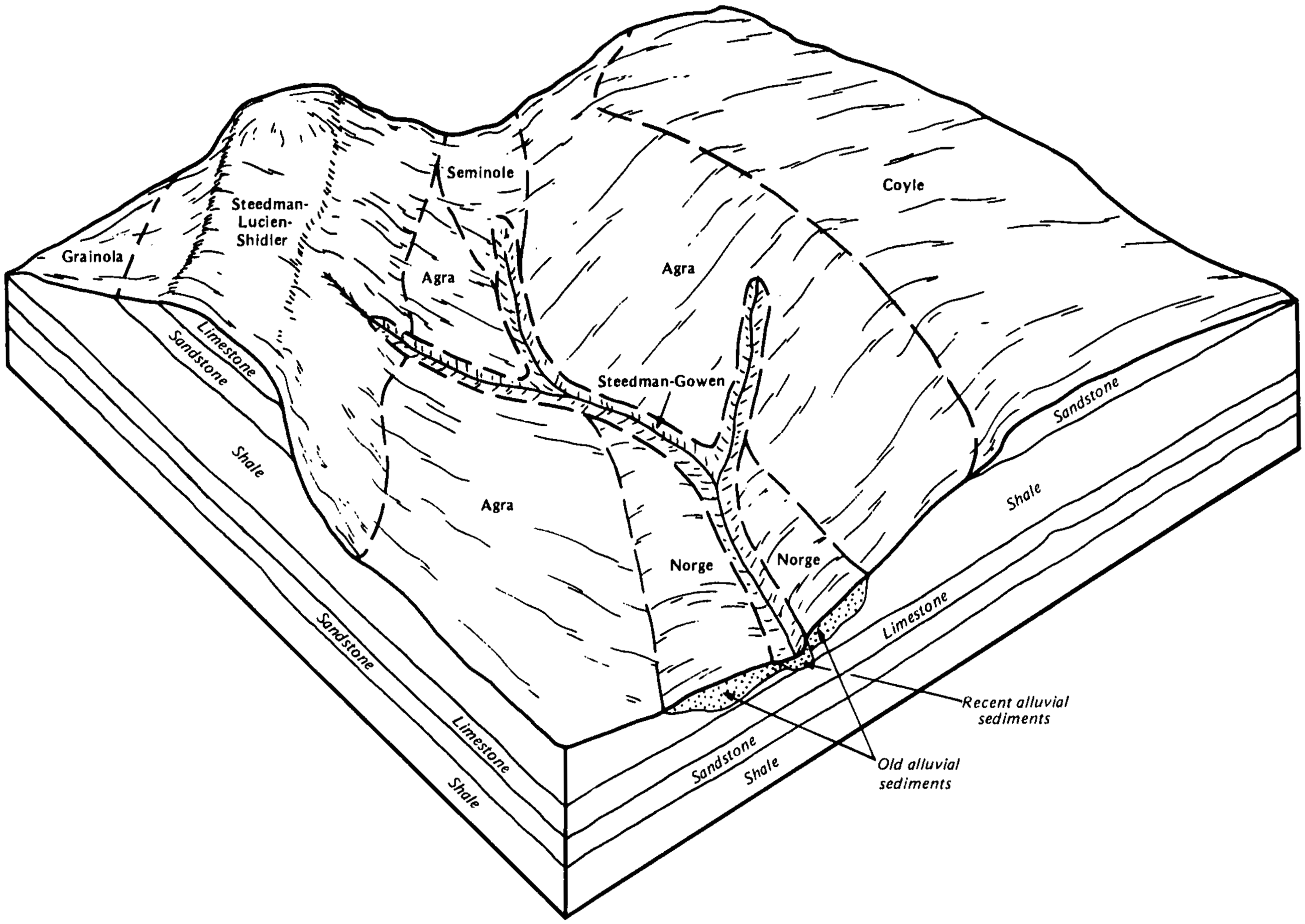


Figure 1.—Typical pattern of soils and underlying material in the Agra-Coyle and Steedman-Lucien-Grainola map units.

2. Renfrow-Kirkland

Nearly level to gently sloping, well drained, loamy soils that formed in material weathered from clayey shale or clayey alluvium under prairie vegetation

These soils are on upland ridgetops and side slopes in the central part of the county. Slope ranges from 0 to 5 percent.

The landforms of this map unit have limited diversity. Patterns of vegetation have very little variety; most land is used for cultivated crops and improved pasture. Wooded areas along narrow streams provide limited diversity to the water elements. Farmsteads are present. Visual diversity of this map unit is low. Changes in the landscape will be visually significant unless steps are taken to blend with existing landscape elements.

This map unit covers about 5 percent of the county. It is about 45 percent Renfrow soils, 19 percent Kirkland soils, and 36 percent minor soils.

Renfrow soils are on broad, convex upland side slopes. These soils are deep, very gently sloping to gently sloping, and well drained. Typically, the surface layer is dark brown silt loam. The subsoil is reddish brown silty clay loam and clay in the upper part and red clay in the lower part.

Kirkland soils are on broad upland ridgetops. These soils are deep, nearly level to very gently sloping, and well drained. Typically, the surface layer is brown silt loam. The subsoil is dark brown, brown, and yellowish red silty clay and red clay.

The minor soils in this map unit are Doolin, Grainola, Huska, Mulhall, and Zaneis soils on uplands and Ashport and Pulaski soils on narrow flood plains.

Areas of this map unit are used mainly for crops or improved pasture. The principal crops are wheat and grain sorghum. Some areas are used for range. The major management concerns are maintaining soil structure and fertility and controlling soil erosion.

These soils have medium potential for cultivated crops, windbreaks, and rangeland. Potential is low for improved pasture and high for openland wildlife habitat. Potential for building sites and sanitary facilities ranges from low to high. Shrinking and swelling and very slow permeability are the main limitations.

3. Renfrow-Coyle-Grainola

Very gently sloping to strongly sloping, well drained, loamy soils that formed in material weathered from shale and sandstone under prairie vegetation

These soils are on upland ridgetops and side slopes in the central and western parts of the county (fig. 2). Slope ranges from 1 to 12 percent.

The range in slope and the occasional rock outcrops provide diversity to the landforms of this map unit. The patterns of vegetation are varied, and land use is mainly tame pasture or native range. Water elements consist of minor drainageways and narrow streams having diverse patterns. Structures range from residences to farmsteads to occasional commercial structures. Visual diversity is medium, and most changes in the landscape will be visually insignificant.

This map unit covers about 24 percent of the county. It is about 21 percent Renfrow soils, 17 percent Coyle soils, 14 percent Grainola soils, and 48 percent minor soils.

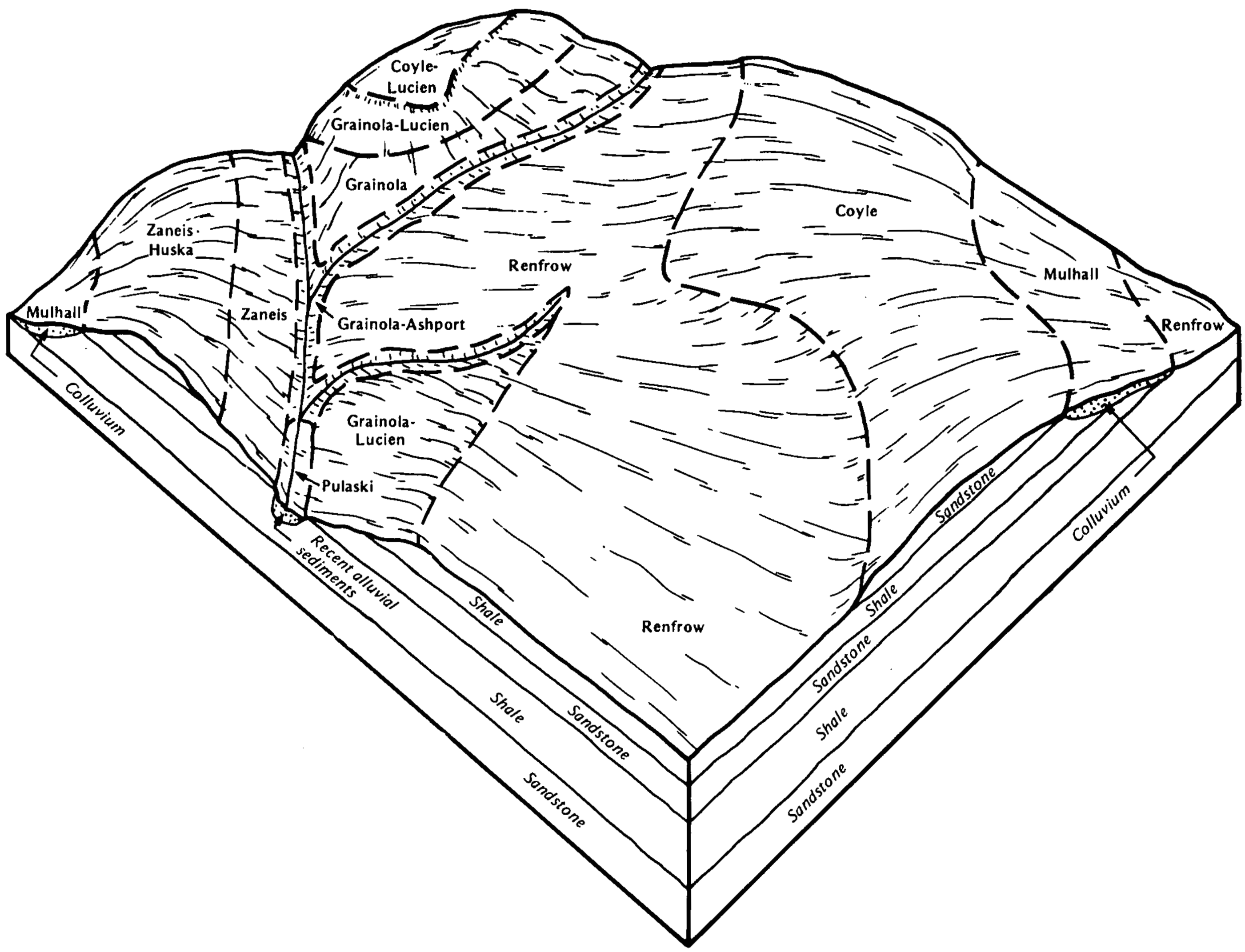


Figure 2.—Typical pattern of soils and underlying material in the Renfrow-Coyle-Grainola map unit.

Renfrow soils are on broad, convex upland side slopes. These soils are deep, very gently sloping to gently sloping, and well drained. Typically, the surface layer is dark reddish gray silt loam. The subsoil is reddish brown silty clay loam and silty clay in the upper part and yellowish red and red silty clay in the lower part.

Coyle soils are on convex upland ridgetops and side slopes. These soils are moderately deep, very gently sloping to sloping, and well drained. Typically, the surface layer is dark reddish gray loam. The subsoil is reddish brown loam, red clay loam, and light red sandy clay loam. The underlying material is red sandstone.

Grainola soils are on convex upland side slopes. These soils are moderately deep, gently sloping to strongly sloping, and well drained. Typically, the surface layer is dark reddish gray clay loam. The subsoil is reddish brown clay and red silty clay. The underlying material is red shale.

The minor soils in this map unit are Doolin, Huska, Lucien, Masham, Mulhall, Stephenville, and Zaneis soils on uplands and Ashport and Pulaski soils on narrow flood plains.

Areas of this map unit are used mainly for improved pasture or range. Some areas are used for crops, and the principal crops are wheat and grain sorghum. The major management concerns are maintaining soil structure and fertility, controlling weed competition, and controlling soil erosion.

These soils have low potential for cultivated crops and improved pasture and medium potential for rangeland and windbreaks. Potential is high for openland wildlife habitat. Potential ranges from low to high for building sites and sanitary facilities. Shrinking and swelling, very slow and slow permeability, and depth to bedrock are the main limitations.

4. Chickasha-Seminole

Nearly level to gently sloping, well drained and moderately well drained, loamy soils that formed in material weathered from sandstone or interbedded sandstone and shale under prairie vegetation

These soils are on upland ridgetops and side slopes in the southeastern part of the county. Slope ranges from 0 to 5 percent.

Landforms in this unit have some degree of diversity. The land is used for range and improved pasture, providing diversity to the patterns of vegetation. Water is limited to minor drainageways, and structures to occasional farmsteads. Visual diversity is medium. Most changes in the landscape will be visually insignificant.

This map unit covers about 3 percent of the county. It is about 35 percent Chickasha soils, 26 percent Seminole soils, and 39 percent minor soils.

Chickasha soils are on broad, convex upland ridgetops and side slopes. These soils are deep, very gently sloping to gently sloping, and well drained. Typically, the surface layer is dark brown loam. The subsoil is dark yellowish brown loam and brown and reddish yellow sandy clay loam. The underlying material is yellowish brown and red sandstone.

Seminole soils are on broad, slightly concave upland ridgetops and side slopes. These soils are deep, nearly level to gently sloping, and moderately well drained. Typically, the surface layer is dark brown loam. The subsoil is dark brown loam in the upper part and coarsely mottled, brown and strong brown clay and clay loam in the lower part.

The minor soils in this map unit are Agra, Coyle, Darnell, Doolin, Steedman, and Stephenville soils on uplands and Easpur, Gowen, and Pulaski soils on narrow flood plains.

Areas of this map unit are used mainly for range and improved pasture. Where the soils are cultivated, the principal crops are wheat and grain sorghum. The main management concerns are maintaining soil fertility, controlling weed competition, and controlling soil erosion.

These soils have low potential for cultivated crops and medium potential for improved pasture, windbreaks, and rangeland. Potential for openland wildlife habitat is high. Potential ranges from low to high for building sites and sanitary facilities. Shrinking and swelling, slow and moderate permeability, and wetness are the main limitations.

Moderately Deep and Shallow, Moderately Well Drained and Well Drained, Loamy Soils on Uplands

The soils in this group cover about 32 percent of Payne County. They are used mainly for rangeland, but some areas are used for improved pasture and small areas are used for crops.

5. Steedman-Lucien-Grainola

Very gently sloping to moderately steep, moderately well drained and well drained, stony and loamy soils that formed in material weathered from shale and sandstone under prairie vegetation

These soils are on upland ridgetops and side slopes in the eastern part of the county (see fig. 1). Slope ranges from 1 to 20 percent.

The range in slope and the occasional rock outcrops and limestone quarries give diversity to the landforms in this unit. Patterns of vegetation are varied. Land use is mostly range with some tame pasture. Stock ponds and drainageways also provide diversity. Most structures are farmsteads and residences. Visual diversity is medium, and changes can be visually significant.

This map unit covers about 8 percent of the county. It is about 19 percent Steedman soils, 18 percent Lucien soils, 16 percent Grainola soils, and 47 percent minor soils.

Steedman soils are on convex upland side slopes. These soils are moderately deep, gently sloping to moderately steep, and well drained and moderately well drained. Typically, the surface layer is dark gray stony clay loam. The subsoil is grayish brown stony clay loam and light brownish gray and pale brown clay. The underlying material is light yellowish brown clayey shale.

Lucien soils are on convex upland ridgetops and upper side slopes. These soils are shallow, very gently sloping to gently sloping, and well drained. Typically, the surface layer is brown fine sandy loam. The subsoil is brown fine sandy loam. The underlying material is brownish yellow sandstone.

Grainola soils are on convex upland side slopes. These soils are moderately deep, gently sloping to moderately steep, and well drained. Typically, the surface layer is reddish brown stony clay loam. The subsoil is reddish brown clay. The underlying material is reddish brown shale.

The minor soils in this map unit are Agra, Coyle, Darnell, Masham, Shidler, and Stephenville soils on uplands and Ashport, Gowen, and Pulaski soils on narrow flood plains. Limestone quarries are found in this map unit scattered throughout the county.

Areas of this map unit are used mainly for range. Some small areas are used for improved tame pasture. The major management concerns are maintaining soil structure and fertility, stocking at proper rates, controlling weeds and brush, and controlling soil erosion.

These soils have low potential for cultivated crops, windbreaks, and improved pasture. They have medium potential for openland wildlife habitat and rangeland. Potential ranges from low to medium for building sites and sanitary facilities. Shrinking and swelling, slow permeability, slope, and depth to rock are the main limitations.

6. Grainola-Masham-Lucien

Very gently sloping to steep, well drained, bouldery and loamy soils that formed in material weathered from shale and sandstone under prairie vegetation

These soils are on upland ridgetops and side slopes in the western part of the county (fig. 3). Slope ranges from 1 to 45 percent.

The wide range in slope gradient and the common rock outcrops produce a varied topography. The pattern of vegetation is also varied. Range is the major land use, although rapid encroachment of cedar trees is a problem. Most farmsteads are visually insignificant. Temporary oil-drilling equipment is common and is visually significant, as are the scars left on the landscape after the drilling has been completed. Stock ponds, streams, and drainageways provide diversity. Visual diversity in this unit is medium. Ugly and extensive scars from early oil field activity demonstrate the map unit's lack of ability to absorb change when soils and plants do not receive proper management.

This map unit covers about 10 percent of the county. It is about 28 percent Grainola soils, 17 percent Masham soils, 16 percent Lucien soils, and 39 percent minor soils.

Grainola soils are on convex upland side slopes. These soils are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the surface layer is reddish brown bouldery clay loam. The subsoil is reddish brown silty clay. The underlying material is reddish brown silty shale.

Masham soils are on convex upland ridgetops and side slopes. These soils are shallow, sloping to steep, and well drained. Typically, the surface layer is reddish brown silty clay loam. The subsoil is reddish brown silty clay. The underlying material is weathered reddish brown shale.

Lucien soils are on convex upland ridgetops and upper side slopes. These soils are shallow, very gently sloping to sloping, and well drained. Typically, the surface layer is reddish brown fine sandy loam. The subsoil is reddish brown fine sandy loam. The underlying material is reddish brown sandstone.

The minor soils in this map unit are Coyle, Darnell, Huska, Mulhall, Renfrow, Stephenville, and Zaneis soils on uplands and Ashport and Pulaski soils on narrow flood plains.

Areas of this map unit are used mainly for range. Some small areas are used for improved pasture or for crops. The main management concerns are maintaining soil structure and fertility, stocking at proper rates, controlling weeds and brush, and controlling erosion.

These soils have low potential for cultivated crops, improved pasture, and windbreaks. They have medium potential for openland wildlife habitat and rangeland. Potential ranges from low to medium for building sites and sanitary facilities. Shrinking and swelling, very slow permeability, slope, and depth to rock are the main limitations.

7. Stephenville-Darnell

Very gently sloping to steep, well drained, loamy soils that formed in material weathered from sandstone under oak savannah

These soils are on upland ridgetops and side slopes throughout the county (fig. 4). Slope ranges from 1 to 45 percent.

The landforms of this unit have a moderate amount of diversity. The vegetation has changed since the 1880's. Range fires, which once controlled woody vegetation and maintained the native grasslands, have since been eliminated. As a result, grazing pressure has allowed woody species to invade. Timber clearing has introduced some variety to the pattern of vegetation. Narrow streams and farm ponds provide some diversity. The structures are occasional residences and farmsteads. The visual diversity of this unit is medium. Changes in the landscape must be carefully analyzed because of the highly erosive nature of the soils.

This map unit covers about 14 percent of the county. It is about 39 percent Stephenville soils, 21 percent Darnell soils, and 40 percent minor soils.

Stephenville soils are on convex ridgetops and side slopes. These soils are moderately deep, very gently sloping to sloping, and well drained. Typically, the surface layer is dark grayish brown fine sandy loam. The subsurface layer is reddish yellow fine sandy loam. The subsoil is red sandy clay loam. The underlying material is light red sandstone.

Darnell soils are on convex ridgetops and side slopes. These soils are shallow, very gently sloping to steep, and well drained. Typically, the surface layer is dark brown fine sandy loam. The subsoil is light brown fine sandy loam. The underlying material is reddish yellow sandstone.

The minor soils in this map unit are Coyle, Grainola, Harrah, Lucien, Mulhall, Renfrow, and Zaneis soils on uplands and Easpur and Pulaski soils on narrow flood plains.

Areas of this map unit are used mainly for range. Some small areas are used for improved pasture or for crops. The main management concerns are maintaining soil structure and fertility, stocking at proper rates, controlling brush and weeds, and controlling erosion.

These soils have low potential for cultivated crops, improved pasture, and rangeland. They have medium potential for windbreaks and openland wildlife habitat.

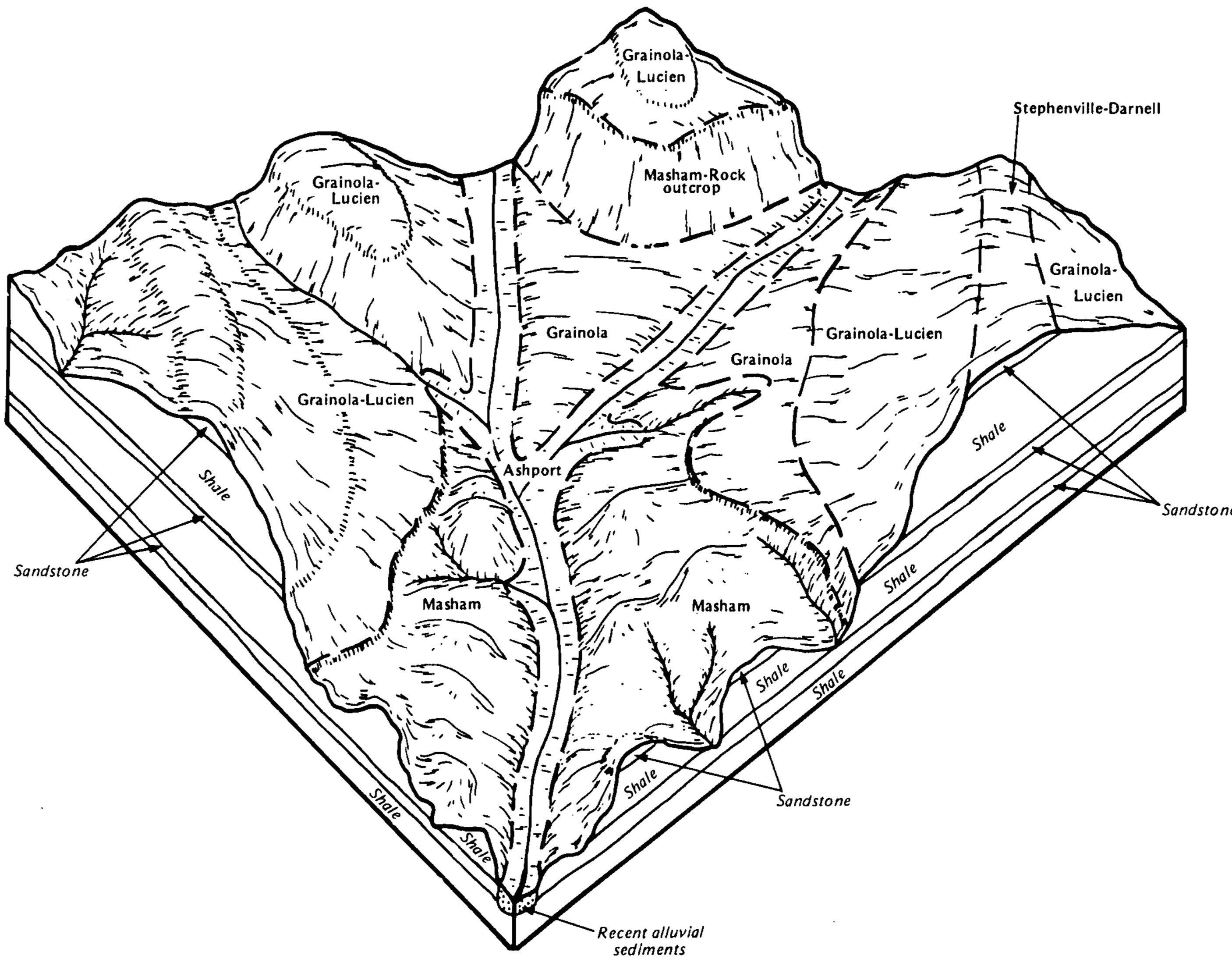


Figure 3.—Typical pattern of soils and underlying material in the Grainola-Masham-Lucien map unit.

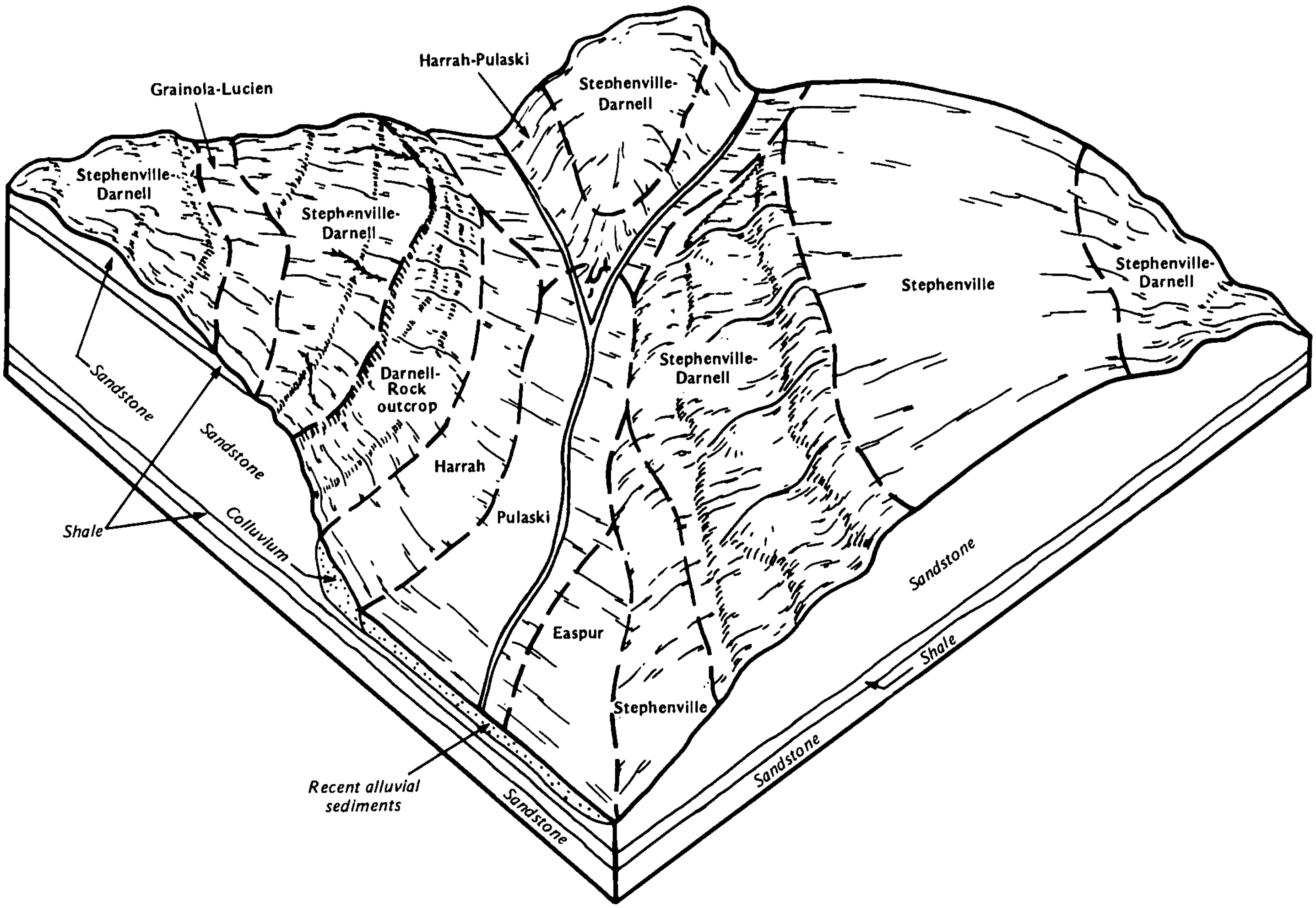


Figure 4.—Typical pattern of soils and underlying material in the Stephenville-Darnell map unit.

Potential ranges from low to high for building sites and sanitary facilities. Depth to rock, slope, and seepage are the main limitations.

Deep, Well Drained and Somewhat Excessively Drained, Loamy and Sandy Soils on Uplands

The soils in this group cover about 18 percent of Payne County. They are used mainly for crops and improved pasture, but some areas are used for range.

8. Norge-Teller-Konawa

Nearly level to sloping, well drained, loamy soils that formed in old alluvial sediment under prairie vegetation or oak savannah

These soils are on upland ridgetops and side slopes across the county (fig. 5). Slope ranges from 0 to 8 percent.

This map unit has a limited variety of landforms. The pattern of vegetation is limited to cropland and improved pasture. Water elements are minor drainageways, and the structures are occasional farmsteads. Visual diversity is low. Changes in the landscape will generally be visually significant unless efforts are made to relate the change to existing landscape elements.

This map unit covers about 10 percent of the county. It is about 30 percent Norge soils, 25 percent Teller soils, 23 percent Konawa soils, and 22 percent minor soils.

Norge soils are on convex ridgetops and side slopes. These soils are deep, very gently sloping to gently sloping, and well drained. Typically, the surface layer is reddish brown loam. The subsoil is reddish brown and yellowish red silty clay loam in the upper part and reddish brown and red clay loam in the lower part.

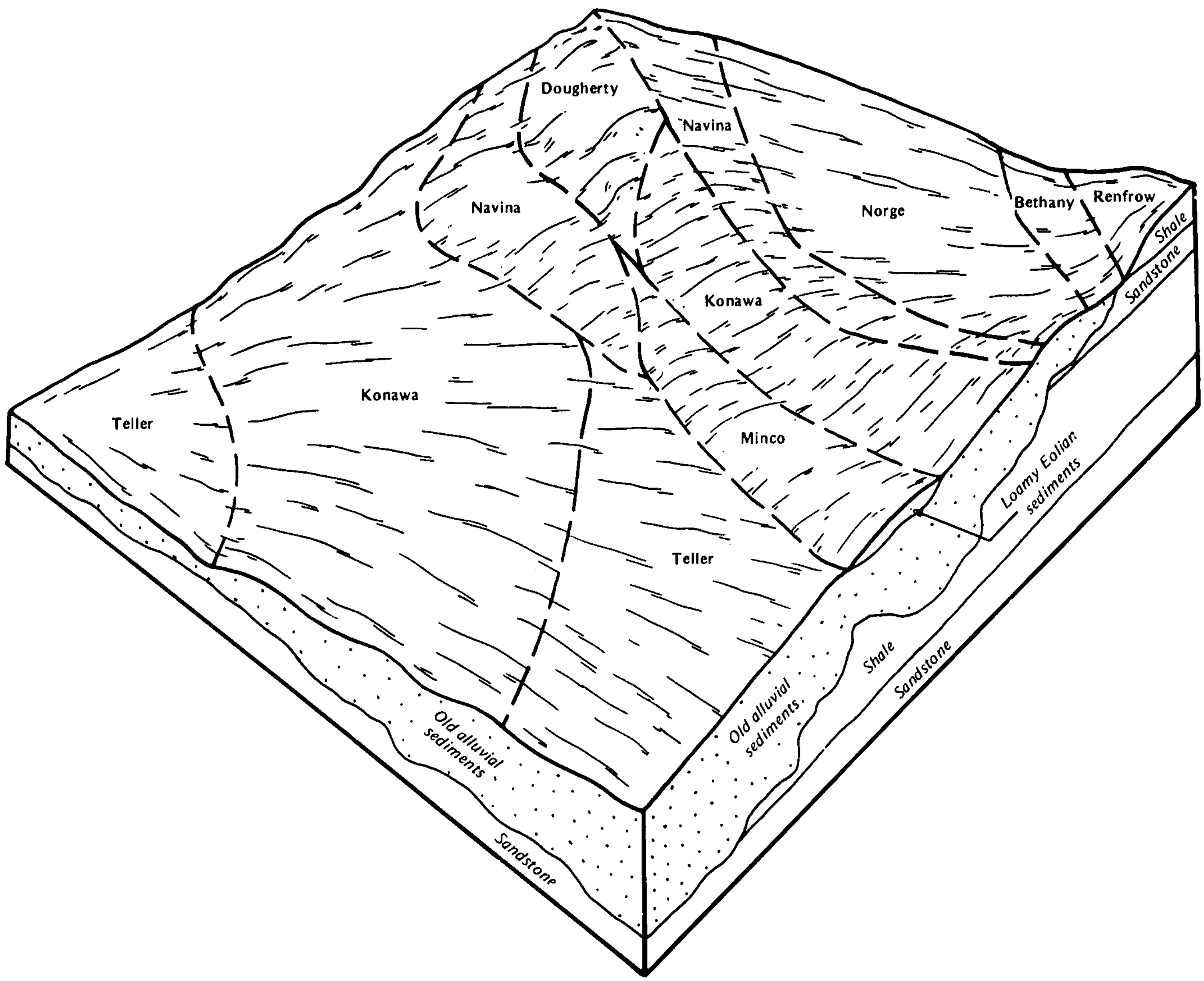


Figure 5.—Typical pattern of soils and underlying material in the Norge-Teller-Konawa map unit.

Teller soils are on slightly convex ridgetops and side slopes. These soils are deep, nearly level to gently sloping, and well drained. Typically, the surface layer is reddish brown loam. The subsoil is reddish brown loam, yellowish red clay loam, and red fine sandy loam.

Konawa soils are on convex ridgetops and side slopes. These soils are deep, very gently sloping to sloping, and well drained. Typically, the surface layer is brown and light reddish brown fine sandy loam. The subsoil is red sandy clay loam and red fine sandy loam.

The minor soils in this map unit are Bethany, Dougherty, Minco, Navina, and Slaughterville soils on uplands and Easpur, Pulaski, and the somewhat poorly drained Tribbey soils on narrow flood plains.

Areas of this map unit are used mainly for crops or improved pasture. The principal crops are wheat, grain sorghum, alfalfa, and peanuts. Some areas are used for range. The main management concerns are maintaining soil structure and fertility, controlling weed competition, and controlling erosion.

These soils have high potential for windbreaks, openland wildlife habitat, improved pasture, and rangeland. Potential for cultivated crops is medium. Potential ranges from low to high for building sites and sanitary facilities. Moderately slow and moderate permeability, shrinking and swelling, and seepage are the main limitations.

9. Konawa-Dougherty-Derby

Nearly level to steep, well drained and somewhat excessively drained, sandy and loamy soils that formed in old alluvial sediment and eolian sediment under oak savannah

These soils are on upland ridgetops and side slopes and dunes on the north side of the Cimarron River (fig. 6). Slope ranges from 1 to 35 percent.

This map unit has a high diversity of landforms. The diverse patterns of vegetation result from soils having the capability of supporting various land uses, primarily range, improved pasture, and some cultivated crops. Streams are common throughout the map unit and are very clear over sandy beds. Visual diversity is high, so changes in the landscape will generally be insignificant.

This map unit covers about 8 percent of the county. It is about 28 percent Konawa soils, 22 percent Dougherty soils, 16 percent Derby soils, and 34 percent minor soils.

Konawa soils are on convex ridgetops and side slopes. These soils are deep, very gently sloping to sloping, and well drained. Typically, the surface layer is brown and light brown loamy fine sand. The subsoil is red sandy clay loam and light red fine sandy loam.

Dougherty soils are on convex side slopes. These soils are deep, nearly level to strongly sloping, and well drained. Typically, the surface layer is grayish brown and very pale brown loamy fine sand. The subsoil is yellowish red sandy clay loam and fine sandy loam. The underlying material is yellowish red loamy fine sand.

Derby soils are on convex hummocks to broad rolling uplands. These soils are deep, very gently sloping to steep, and somewhat excessively drained. Typically, the surface layer is brown fine sandy loam. The subsurface layer is light brown loamy fine sand and pink fine sand. The subsoil is reddish yellow and pink fine sand with thin bands of yellowish red fine sand and loamy fine sand.

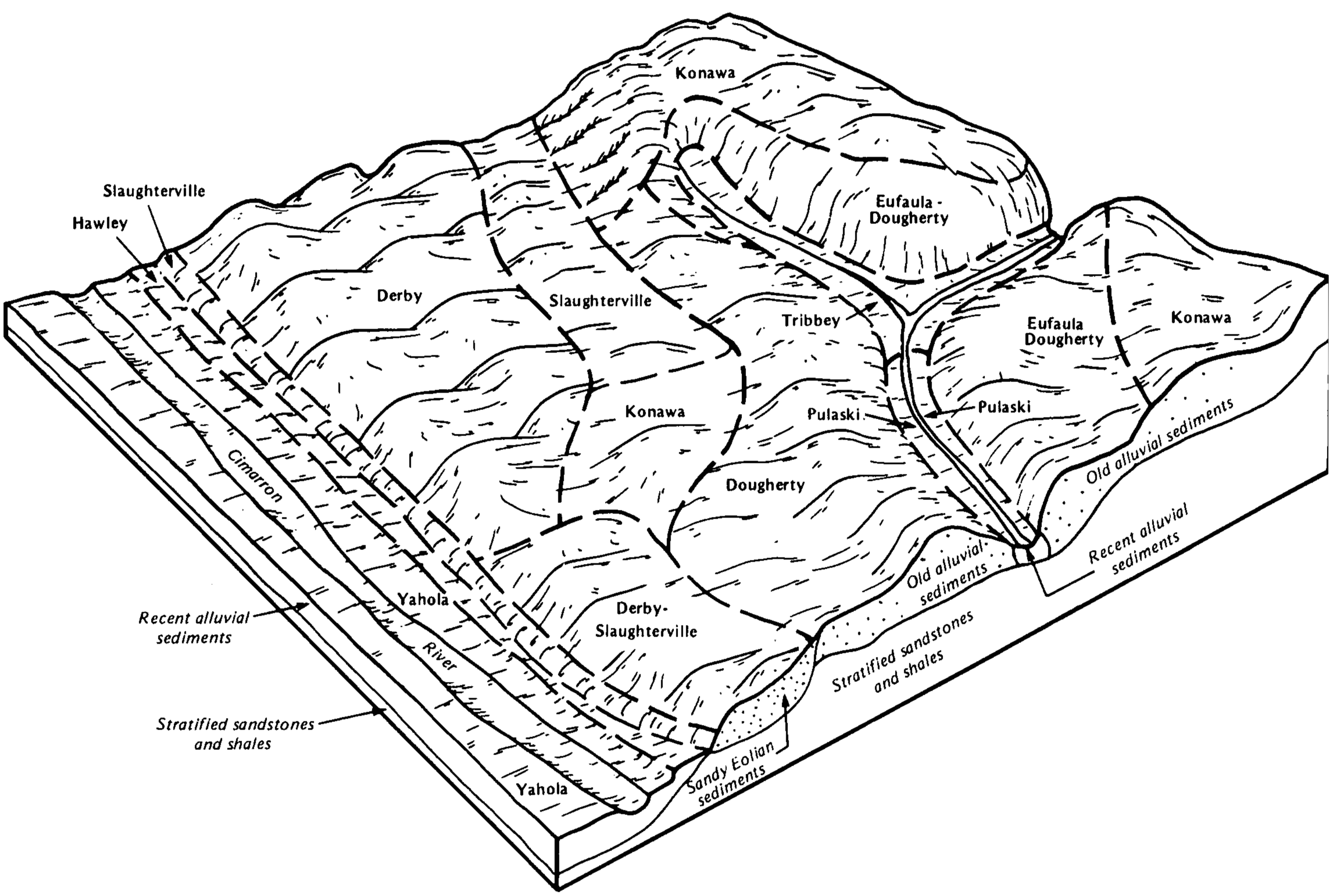


Figure 6.—Typical pattern of soils and underlying material in the Konawa-Dougherty-Derby map unit.

The minor soils in this map unit are Eufaula, Goodnight, and Slaughterville soils on uplands and Pulaski and the somewhat poorly drained Tribbey soils on narrow flood plains.

Areas of this map unit are used mainly for range or improved pasture. Where the soils are cultivated, the principal crops are wheat, peanuts, and grain sorghum. The main management concerns are maintaining soil structure and fertility, controlling brush and weed competition, and controlling wind and water erosion.

These soils have low potential for cultivated crops, improved pasture, and rangeland. Potential for windbreaks and openland wildlife habitat is high. Potential ranges from low to high for building sites and sanitary facilities. Seepage and slope are the main limitations.

Deep, Well Drained and Somewhat Excessively Drained, Loamy and Sandy Soils on Flood Plains

The soils in this group cover about 10 percent of Payne County. They are used mainly for crops, but some areas are used for improved pasture or range.

10. Yahola-Gaddy-Hawley

Nearly level to undulating, well drained and somewhat excessively drained, loamy and sandy soils that formed in alluvial sediment under prairie grasses and scattered bottom land hardwoods

These soils are on flood plains along the Cimarron River (fig. 7). Slope ranges from 0 to 3 percent.

The limited diversity in landforms is a result of the subdued topography. The pattern of vegetation shows little diversity because most of the unit is used for crops and improved pasture. The Cimarron River, with its varied shoreline, provides a high level of diversity to water elements. Structures are few because of the flooding. Visual diversity is medium. Changes in the landscape will be visually insignificant in most cases.

This map unit covers about 4 percent of the county. It is about 25 percent Yahola soils, 20 percent Gaddy soils, 20 percent Hawley soils, and 35 percent minor soils.

Yahola soils are in low positions on flood plains near the stream channels. These soils are deep, nearly level, and well drained. They are occasionally flooded for very brief periods. Typically, the surface layer is reddish

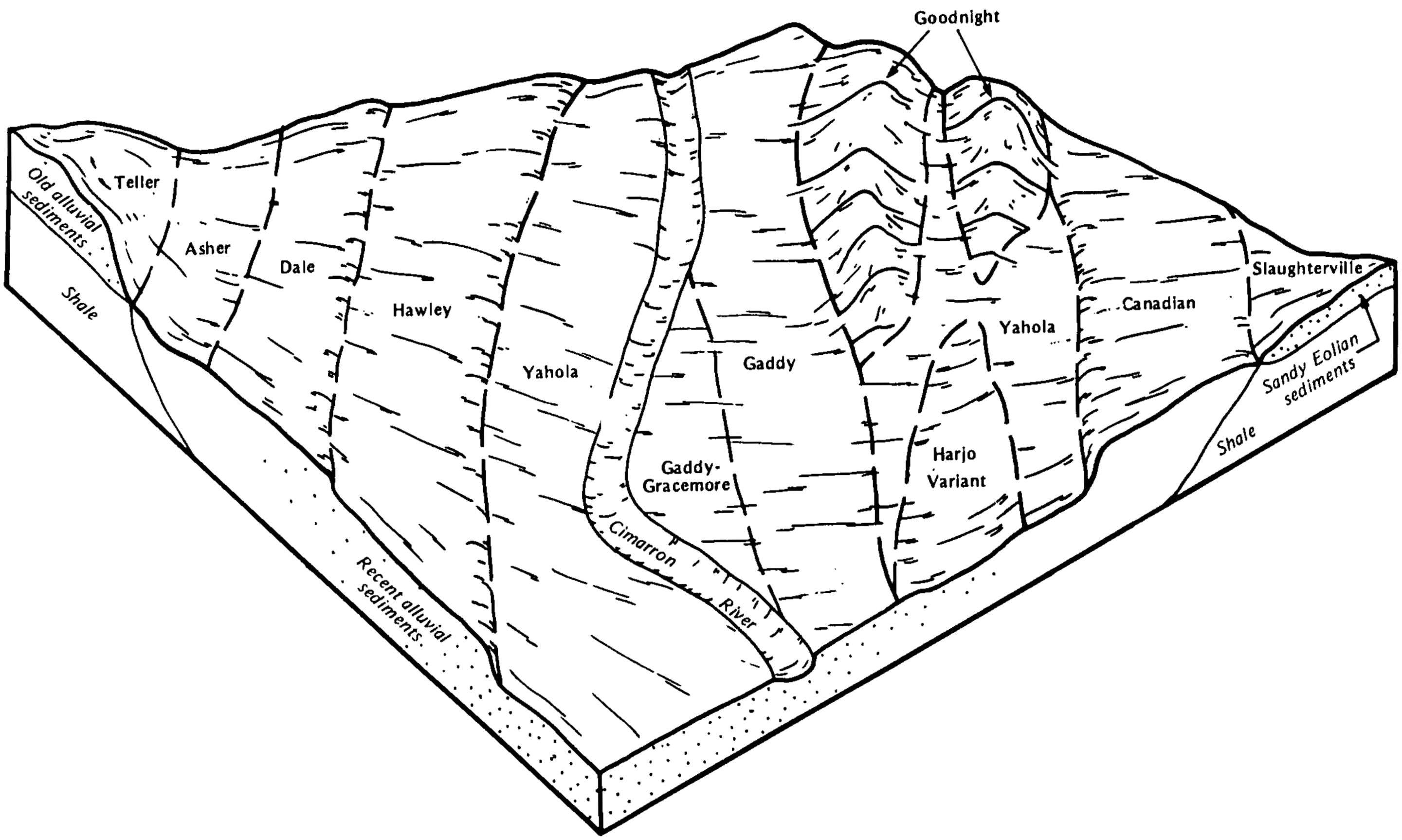


Figure 7. Typical pattern of soils and underlying material in the Yahola-Gaddy-Hawley map unit.

brown fine sandy loam. The underlying material is reddish yellow and light red fine sandy loam and loamy fine sand and has thin strata of fine sandy loam to loam.

Gaddy soils are in the lowest positions on flood plains adjacent to the stream channels. These soils are deep, nearly level, and somewhat excessively drained. They are frequently to occasionally flooded for very brief periods. Typically, the surface layer is pale brown and light brown loamy fine sand. The underlying material is pink fine sand and light brown loamy fine sand and has thin strata of fine sandy loam.

Hawley soils are in slightly higher positions on flood plains than the Yahola and Gaddy soils. Hawley soils are deep, undulating, and well drained. They are rarely flooded for very brief periods. Typically, the surface layer is brown fine sandy loam. The subsoil is yellowish red fine sandy loam. The underlying material is reddish yellow fine sandy loam with thin strata of fine sand to loam.

The minor soils in this map unit are the well drained Asher, Canadian, and Dale soils; the excessively drained Goodnight soils; and the poorly drained and somewhat poorly drained Harjo Variant and Gracemore soils. The Harjo Variant and Gracemore soils have a water table within 40 inches of the surface most of the year.

Areas of this map unit are used mainly for crops and improved pasture. Some soils are used for range. The principal crops are wheat, alfalfa, and grain sorghum. The main management concerns are maintaining soil structure and fertility, controlling weed competition, and controlling wind erosion.

These soils have high potential for cultivated crops, improved pasture, windbreaks, openland wildlife habitat, and rangeland. Potential ranges from low to high for building sites and sanitary facilities. Flooding is the main limitation.

11. Pulaski-Easpur-Ashport

Nearly level, well drained, loamy soils that formed in alluvial sediment under prairie grasses and scattered bottom land hardwoods

These soils are on narrow flood plains throughout the county. Slope ranges from 0 to 1 percent.

The nearly level landforms of this map unit offer little diversity. The pattern of vegetation is limited; 80 percent of the map unit is used for cultivated crops. The water features are streams and minor drainageways. Structures are uncommon because of the flooding. Visual diversity of this unit is low, and changes in the landscape will be visually significant unless efforts are made to relate the changes to existing landscape elements.

This map unit covers about 6 percent of the county. It is about 37 percent Pulaski soils, 32 percent Easpur soils, 12 percent Ashport soils, and 19 percent minor soils.

Pulaski soils are in lower positions on flood plains adjacent to the stream channels. These soils are deep, nearly level, and well drained. They are occasionally or frequently flooded for very brief periods. Typically, the surface layer is reddish brown fine sandy loam. The underlying material is red fine sandy loam with strata of loamy fine sand to very fine sandy loam.

Easpur soils are in slightly higher positions on flood plains than Pulaski soils. Easpur soils are deep, nearly level, and well drained. They are occasionally flooded for brief periods. Typically, the surface layer is reddish brown loam. The subsoil is reddish brown fine sandy loam and clay loam. The underlying material is stratified reddish brown loam, fine sandy loam, and clay loam. Buried horizons are common.

Ashport soils are in smooth areas on flood plains. These soils are deep, nearly level, and well drained. They are occasionally flooded for brief periods. Typically, the surface layer is dark reddish gray silty clay loam. The subsoil is reddish brown silty clay loam. Buried horizons are common.

The minor soils in this map unit are the well drained Dale, McLain, and Port soils and the moderately well drained Oscar soils.

Areas of this map unit are used mainly for crops or improved pasture. Some areas are used for range. The principal crops are wheat, alfalfa, grain sorghum, and pecans. The main management concerns are maintaining soil structure and fertility, controlling weed competition, and controlling run-on water from higher lying areas.

These soils have high potential for cultivated crops, improved pasture, windbreaks, openland wildlife habitat, and rangeland. Potential ranges from low to medium for building sites and sanitary facilities. Flooding is the main limitation.

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.

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, Teller fine sandy loam, 1 to 3 percent slopes, is one of several phases in the Teller series.

Some map units are made up of two or more major soils. These map units are called soil complexes 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. Grainola-Lucien complex, 5 to 12 percent slopes, 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. Konawa and Teller soils, 2 to 6 percent slopes, eroded, 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. Oil-waste land 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.

The soils are rated for their potential for several selected land uses. The soil potential ratings indicate the relative quality of a soil for a particular use compared with other soils in this county. The rating of potential is based on yield or performance level, the cost of minimizing the soil limitations, and social, economic, or environmental values.

Soil potential classes are defined in terms of the production or performance expected of a soil if suitable measures are taken to overcome its limitations, the cost of such measures, and the limitations that remain after measures have been applied. The following classes are used in this survey:

High potential: Production or performance is equal to or above local standards. Soil conditions are exceptionally favorable, or the cost of measures for overcoming soil limitations are low in relation to the expected performance or yields. There are no soil limitations, or the continuing limitations after corrective measures have been applied do not detract from environmental quality or reduce economic returns.

Medium potential: Production or performance is somewhat below local standards. The cost of measures for overcoming soil limitations is high, or continuing limitations after corrective measures have been applied detract from environmental quality or reduce economic returns.

Low potential: Production or performance is significantly below local standards. The measures required to overcome the severe soil limitations are too costly to be practical, or continuing limitations after corrective measures have been applied detract from environmental quality or reduce economic returns.

Soil potential ratings help decisionmakers to determine the relative suitability of soils for a given use. They are used with other resource information in planning land use. Soil potential ratings do not constitute recommendations for land use.

1—Agra-Urban land complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping, loamy Agra soil and Urban land on uplands in the eastern part of Payne County. The Agra soil is deep and moderately well drained. Areas of the Agra soil and Urban land are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 acres to more than 1,000 acres in size.

This complex is 40 percent Agra soil, 30 percent Urban land, and 30 percent included soils.

The Agra soil typically has a surface layer of grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. The upper 4 inches is dark grayish brown silty clay loam, the next 8 inches is dark grayish brown silty clay, the next 27 inches is brown silty clay, and the lower 15 inches is brown clay loam with coarse yellowish red mottles.

This soil is high in natural fertility and organic matter content. Reaction of the surface layer ranges from slightly acid to mildly alkaline. A perched water table is at a depth of 3 to 4 feet in winter and spring. Available water capacity is high. Permeability is very slow, and surface runoff is medium to rapid. The root zone is deep, but roots have difficulty penetrating the dense clayey subsoil.

Urban land consists of areas that are covered with dwellings, paved roads, commercial buildings, parking lots, and similar structures.

Included with this complex in mapping are small areas of Coyle, Huska, Mulhall, Norge, Seminole, and Steedman soils. Coyle soils are on convex ridgetops above the Agra soil. Huska and Seminole soils are in slightly concave areas. Mulhall soils are on smooth side slopes above the Agra soil. Norge soils are near drainageways below the Agra soil. Steedman soils are on steeper side slopes. The included soils make up about 30 percent of the map unit, but individual areas generally are smaller than 5 acres.

This Agra soil is used for urban development.

This complex is unsuited to crops, tame pasture and hay, range, or wildlife habitat.

This complex has medium potential for windbreaks and environmental plantings. The dense clayey subsoil restricts root growth of many of the plants that can be established on the Agra soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, very slow permeability, and wetness are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is not assigned to a capability subclass or range site.

2—Coyle loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on convex upland ridgetops. It is moderately deep and well drained. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark reddish gray loam about 11 inches thick. The subsoil extends to a depth of about 39 inches. The upper 3 inches is reddish brown loam, the next 17 inches is red clay loam, and the lower 8 inches is light red sandy clay loam. The underlying material to a depth of 42 inches or more is red weathered sandstone that is rippable when moist.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to mildly alkaline. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is moderately deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Chickasha, Grainola, Huska, Lucien, Mulhall, Renfrow, Steedman, Stephenville, and Zaneis soils. Agra, Grainola, Renfrow, and Steedman soils are on convex side slopes below the Coyle soil. Chickasha, Lucien, Stephenville, and Zaneis soils are in positions similar to that of the Coyle soil. Huska soils are in slightly concave areas. Mulhall soils are on smooth side slopes below the Coyle soil. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Coyle soil are used for crops or tame pasture. The principal crops are wheat and grain sorghum.

This soil has medium potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The moderate soil depth restricts root development.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plantings, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Depth to rock is the main limitation, but it can be overcome by proper design or soil modification. Septic tank absorption fields will function in this soil only if the soil is modified. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

3—Coyle loam, 3 to 5 percent. This gently sloping, loamy soil is on convex upland side slopes. It is moderately deep and well drained. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown loam about 12 inches thick. The subsoil extends to a depth of about 39 inches. The upper 6 inches is brown loam, the next 14 inches is brown and strong brown clay loam, and the lower 7 inches is reddish yellow clay loam. The underlying material is reddish yellow sandstone that is rippable when moist.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to mildly alkaline. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is moderately deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Chickasha, Grainola, Huska, Lucien, Mulhall, Renfrow, Steedman, Stephenville, and Zaneis soils. Agra, Grainola, Renfrow, and Steedman soils are on convex side slopes below the Coyle soil. Chickasha, Lucien, Stephenville, and Zaneis soils are in positions similar to that of the Coyle soil. Huska soils are in slightly concave areas. Mulhall soils are on smooth side slopes below the Coyle soil. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Coyle soil are used for crops or tame pasture. The principal crops are wheat and grain sorghum.

This soil has medium potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The moderate soil depth restricts root development.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Slope and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields will function in this soil only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

4—Coyle loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping, loamy soil is on convex ridgetops and side slopes on eroded uplands. It is moderately deep and well drained. This soil has been cultivated, and water erosion has removed much of the surface layer leaving the subsoil exposed in more than half of the area. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil extends to a depth of about 30 inches. The upper 4 inches is reddish brown loam, the next 13 inches is yellowish red sandy clay loam, and the lower 6 inches is reddish yellow sandy clay loam. The underlying material is reddish yellow sandstone that is rippable when moist.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Tilth is good, but surface crusting is common. The root zone is moderately deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Chickasha, Grainola, Huska, Lucien, Mulhall, Renfrow, Steedman, Stephenville, and Zaneis soils. Agra, Grainola, Renfrow, and Steedman soils are on convex side slopes below the Coyle soil. Chickasha, Lucien, Stephenville, and Zaneis soils are in positions similar to that of the Coyle soil. Huska soils are in slightly concave areas. Mulhall soils are on smooth side slopes below the Coyle soil. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Coyle soil are used for tame pasture, crops, or range. The principal crops are wheat and grain sorghum.

This soil has low to medium potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The moderate soil depth restricts root development.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. There are no major limitations. Slope and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields will function only if the soil is modified. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

5—Bethany silt loam, 0 to 2 percent slopes. This nearly level to very gently sloping, loamy soil is on broad, convex ridgetops on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil extends to a depth of about 65 inches. The upper 4 inches is dark brown silty clay loam, the next 25 inches is dark brown and brown silty clay loam, and the lower 26 inches is yellowish red silty clay loam. The underlying material to a depth of 80 inches or more is red, stratified shale and sandy shale.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is slow, and surface runoff is slow. Tilth is good, but the soil should not be worked when wet. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Kirkland, Navina, Norge, and Renfrow soils. Kirkland soils are in slightly concave areas intermingled with the Bethany soil. Navina and Norge soils are in positions similar to that of the Bethany soil. Renfrow soils are on side slopes above the Bethany soil. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Bethany soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

6—Pulaski fine sandy loam, frequently flooded. This nearly level, loamy soil is on low, narrow flood plains. It is deep and well drained. This soil is subject to damaging floods at least once in 2 years. These floods occur from March through October and may last as long as 72 hours. Individual areas are long and narrow in shape and range from 10 to 200 acres in size.

Typically, the surface layer is reddish brown fine sandy loam about 8 inches thick. The underlying material extends to a depth of 72 inches or more. The upper 12 inches is reddish brown loam, the next 17 inches is reddish brown fine sandy loam, the next 10 inches is reddish brown loam, and the lower part is reddish brown fine sandy loam stratified with fine sand.

Natural fertility is medium, and organic matter content is low. Reaction of the surface layer is neutral. Available water capacity is medium. Permeability is moderately rapid, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Ashport, Easpur, Gowen, Harrah, Port, and Tribbey soils. Ashport soils are in slightly concave areas. Easpur soils are in positions similar to that of the Pulaski soil. Gowen soils are in similar positions in the eastern part of Payne County. Harrah soils are in higher positions. Port soils are in slightly higher positions. Tribbey soils are in slightly lower, wetter areas. The included soils make up about 30 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range. A few areas are used for tame pasture.

This soil is not suited to cultivated crops. The flooding is very difficult to overcome.

Potential for tame pasture and hay is low. Frequent flooding may make establishment of improved grasses difficult. Bermudagrass and other improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The flooding can make establishment of plants difficult.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grasses and legumes and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low. Seepage is a limitation. The hazard of flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass Vw; Loamy Bottomland range site.

7—Chickasha fine sandy loam, 2 to 5 percent slopes, eroded. This very gently to gently sloping, loamy soil is on convex ridgetops and side slopes on eroded uplands mainly in the southeastern part of Payne County. It is deep and well drained. This soil has been cultivated, and water erosion has removed much of the surface layer leaving the subsoil exposed in much of the area. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 43 inches. The upper 22 inches is brown sandy clay loam, and the lower 13 inches is mottled yellow sandy clay loam. The underlying material is yellowish red sandstone that is rippable when moist.

Natural fertility and organic matter content are medium. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, but surface crusting is common. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Doolin, Seminole, and Zaneis soils. Coyle and Zaneis soils are in positions similar to that of the Chickasha soil. Doolin soils are on broad, slightly concave ridgetops above the Chickasha soil. Seminole soils are on slightly concave side slopes below the Chickasha soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for crops or tame pasture. The principal crop is wheat.

This soil has low potential for crops. Small grains, vegetables, and fruits are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability, slope, and depth to rock are limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function in this soil if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

8—Chickasha loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on convex ridgetops and side slopes on uplands mainly in the southeastern part of Payne County. It is deep and well drained. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown loam about 12 inches thick. The subsoil extends to a depth of about 44 inches. The upper 7 inches is dark yellowish brown loam, the next 9 inches is brown sandy clay loam, the next 6 inches is reddish yellow sandy clay loam, and the lower 10 inches is coarsely mottled sandy clay loam. The underlying material is yellowish brown and red sandstone that is rippable when moist.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Doolin, Seminole, and Zaneis soils. Coyle and Zaneis soils are in positions similar to that of the Chickasha soil. Doolin soils are on broad, slightly concave ridgetops above the Chickasha soil. Seminole soils are on slightly concave side slopes below the Chickasha soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Chickasha soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has medium potential for crops. Small grains, row crops, alfalfa, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function in this soil if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

9—Chickasha loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on convex side slopes on uplands mainly in the southeastern part of Payne County. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loam about 13 inches thick. The subsoil extends to a depth of about 52 inches. The upper 5 inches is brown loam, the next 10 inches is strong brown sandy clay loam, the next 14 inches is reddish yellow sandy clay loam, and the lower 10 inches is coarsely mottled sandy clay loam. The underlying material is red sandstone that is rippable when moist.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Doolin, Seminole, and Zaneis soils. Coyle and Zaneis soils are in positions similar to that of the Chickasha soil. Doolin soils are on broad, slightly concave ridgetops above the Chickasha soil. Seminole soils are on slightly concave side slopes below the Chickasha soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Chickasha soil are used for crops or tame pasture. The principal crops are wheat and grain sorghum.

This soil has medium to high potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability, slope, and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

10—Darnell-Rock outcrop complex, 8 to 45 percent slopes. This complex consists of strongly sloping to steep, loamy Darnell soil and outcrops of sandstone on uplands. The Darnell soil is shallow and is well drained to somewhat excessively drained. The pattern of soil and Rock outcrop is variable. Areas of the soil and Rock outcrop are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 100 acres in size.

This complex is 40 percent Darnell soil, 20 percent Rock outcrop, and 40 percent included soils. The Darnell soil is on convex side slopes. The Rock outcrop is below the soil, or it is intermingled with the soil throughout the areas.

The Darnell soil typically has a surface layer of brown fine sandy loam about 4 inches thick. The subsoil is pale brown fine sandy loam to a depth of about 11 inches. The underlying material to a depth of 20 inches or more is yellowish brown sandstone.

This soil is low in natural fertility and organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is rapid. The root zone is shallow and can be easily penetrated by plant roots.

The Rock outcrop is sandstone bedrock exposed at the surface or covered by less than 4 inches of soil.

Included in mapping are small areas of Harrah, Lucien, Masham, and Stephenville soils. Harrah soils are on lower, slightly concave side slopes adjacent to the stream channel. Lucien soils are in positions similar to that of the Darnell soil. Masham soils occur where thin beds of shale, which are interbedded with the sandstone, are exposed. Stephenville soils are on convex ridgetops and side slopes above the Darnell soil. The included soils make up about 40 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range.

This complex is not suited to cultivated crops or to tame pasture and hay. The very severe hazard of erosion, steep slopes, and shallow depth to bedrock are limitations that are very difficult to overcome.

This complex has low potential for range. Little bluestem and big bluestem are suited. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This complex has low potential for windbreaks and environmental plantings. The shallow depth of the Darnell soil restricts root development. The lack of available water in the subsoil restricts the growth and development of trees.

This complex has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to the Darnell soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Slope, seepage, and depth to rock are the main limitations of the Darnell soil. Onsite investigation is essential.

This complex is in capability subclass VIIs. The Darnell soil is in Shallow Savannah range site, and Rock outcrop is not assigned to a range site.

11—Stephenville-Darnell complex, 1 to 8 percent slopes. This complex consists of very gently sloping to sloping soils on uplands. The Stephenville soil is moderately deep and well drained. The Darnell soil is shallow and is well drained and somewhat excessively drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 300 acres in size.

This complex is 45 percent Stephenville soil, 35 percent Darnell soil, and 20 percent included soils. The Stephenville soil is on broad, convex side slopes, and the Darnell soil is on broad, convex ridgetops.

The Stephenville soil typically has a surface layer of dark grayish brown fine sandy loam about 5 inches thick. The subsurface layer is yellowish red fine sandy loam about 6 inches thick. The subsoil is red sandy clay loam to a depth of about 40 inches. The underlying material is light red sandstone that is hard when dry and rippable when moist.

The Stephenville soil is low to medium in natural fertility and medium in organic matter content. Reaction of the surface layer is medium acid or slightly acid. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. The root zone is moderately deep and can be easily penetrated by plant roots.

The Darnell soil typically has a surface layer of dark brown fine sandy loam about 5 inches thick. The subsoil is light brown fine sandy loam about 13 inches thick. The underlying material is reddish yellow sandstone that is hard when dry and rippable when moist.

The Darnell soil is low in natural fertility and organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is medium. The root zone is shallow and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Coyle, Grainola, Harrah, and Lucien soils and of a soil that is similar to Stephenville soils but that has more clay in the lower part of the subsoil. Coyle soils are on ridge crests. Grainola soils are on upper side slopes. Harrah soils are on slightly concave lower side slopes. Lucien soils are on convex ridge crests. The soil similar to Stephenville soils is on upper side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for improved pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion and shallow depth to bedrock are very difficult to overcome.

Potential for tame pasture and hay is low. The very severe hazard of erosion and shallow depth to bedrock make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils (fig. 8). Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have low potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium potential for windbreaks and environmental plantings. The shallow depth of the Darnell soil restricts root development.

These soils have medium potential for openland and rangeland wildlife habitat and low potential for wetland

Figure 8.—This pasture of weeping lovegrass has been established on Stephenville-Darnell complex, 1 to 8 percent slopes.

wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Slope and depth to rock are the main limitations of these soils. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields will function in these soils only if the soil is extensively modified. Onsite investigation is essential.

This complex is in capability subclass VIe. The Stephenville soil is in Sandy Savannah range site, and the Darnell soil is in Shallow Savannah range site.

12—Agra silt loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, convex ridgetops and side slopes on uplands in the eastern part of Payne County. It is deep and moderately well drained. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is brown and dark brown silt loam about 11 inches thick. The subsoil extends to a depth of about 80 inches. The upper 5 inches is brown silty clay loam, the next 14 inches is brown silty clay, the next 12 inches is light brown silty clay, and the lower 38 inches is coarsely mottled silty clay.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. A perched water table is at a depth of 3 to 4 feet in winter and spring. Permeability is very slow, and surface runoff is medium. Tilth is good, but should not be worked when wet. The root zone is deep, but roots have difficulty penetrating the dense, clayey subsoil.

Included with this soil in mapping are small areas of Coyle, Huska, Mulhall, Norge, and Seminole soils. Coyle soils are on convex ridgetops. Huska and Seminole soils are in concave areas at the heads of drainageways. Mulhall soils are on smooth side slopes above the Agra soil. Norge soils are near drainageways below the Agra soil. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Agra soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and grain sorghum.

This soil has high potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense clayey subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland wildlife habitat, medium potential for rangeland wildlife habitat, and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from high to low. Shrinking and swelling, very slow permeability, and wetness are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Claypan Prairie range site.

13—Agra silt loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on convex side slopes on uplands in the eastern part of Payne County. It is deep and moderately well drained. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The subsoil extends to a depth of about 76 inches. The upper 5 inches is brown silty clay loam, the next 11 inches is yellowish brown silty clay loam, the next 15 inches is yellowish brown silty clay, and the lower 31 inches is reddish yellow silty clay.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. A perched water table is at a depth of 3 to 4 feet during winter and spring. Permeability is very slow, and surface runoff is rapid. Tilth is good, but the soil should not be worked when wet. The root zone is deep, but roots have difficulty penetrating the dense, clayey subsoil.

Included with this soil in mapping are small areas of Coyle, Mulhall, Norge, and Steedman soils. Coyle soils are on convex ridgetops and commonly are above the Agra soil. Mulhall soils are on smooth side slopes above the Agra soil. Norge soils are near drainageways below the Agra soil. Steedman soils are on steeper side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Agra soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and grain sorghum.

This soil has medium to low potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense clayey subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland wildlife habitat, medium potential for rangeland wildlife habitat, and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high.

Shrinking and swelling, very slow permeability, and wetness are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVe; Claypan Prairie range site.

14—Agra silt loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping, loamy soil is on convex ridgetops and side slopes on eroded uplands in the eastern part of Payne County. It is deep and moderately well drained. This soil has been cultivated, and water erosion has removed much of the surface layer leaving the subsoil exposed in much of the area. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil extends to a depth of about 64 inches. The upper 29 inches is yellowish brown clay, and the lower 29 inches is strong brown clay.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. A perched water table is at a depth of 3 to 4 feet in winter and spring. Permeability is very slow, and surface runoff is rapid. Tilth is poor, and surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense, clayey subsoil.

Included with this soil in mapping are small areas of Coyle, Huska, Mulhall, Norge, and Steedman soils. Coyle soils are on convex ridgetops and commonly are above the Agra soil. Huska soils are in concave areas at the heads of drainageways. Mulhall soils are on smooth side slopes above the Agra soil. Norge soils are near drainageways below the Agra soil. Steedman soils are on steeper side slopes. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Agra soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and grain sorghum.

This soil has low potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense clayey subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland wildlife habitat, medium potential for rangeland wildlife habitat, and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, very slow permeability, and wetness are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVe; Claypan Prairie range site.

15—Dougherty loamy fine sand, 3 to 8 percent slopes. This gently sloping to sloping, sandy soil is on convex side slopes on uplands on the north side of the Cimarron River. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The subsurface layer is very pale brown loamy fine sand about 20 inches thick. The subsoil extends to a depth of about 54 inches. The upper 16 inches is yellowish red sandy clay loam, and the lower 12 inches is yellowish red fine sandy loam. The underlying material to a depth of 70 inches or more is yellowish red loamy fine sand.

Natural fertility and organic matter content are low. Reaction of the surface layer is medium acid or slightly acid. Available water capacity is medium. Permeability is moderate and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Eufaula, Konawa, Slaughterville, and Teller soils. Eufaula soils are on steeper side slopes below the Dougherty soil. Konawa and Teller soils are on ridgetops above the Dougherty soil. Slaughterville soils are in positions similar to that of the Dougherty soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for crops or tame pasture. The principal crops are wheat and peanuts.

This soil has low potential for crops. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem, big bluestem, and sand bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IVe; Deep Sand Savannah range site.

16—Norge-Urban land complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping Norge soil and Urban land on broad ridgetops and side slopes on uplands. The Norge soil is deep and well drained. Areas of the Norge soil and Urban land are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 100 to 500 acres in size.

This complex is 40 percent Norge soil, 30 percent Urban land, and 30 percent included soils. The Norge soil is in undisturbed areas, such as lawns, parks, and vacant lots.

The Norge soil typically has a surface layer of reddish brown loam about 9 inches thick. The upper part of the subsoil is reddish brown clay loam about 24 inches thick. The middle part of the subsoil is yellowish red clay loam 17 inches thick. The lower part of the subsoil is reddish brown clay loam that extends to a depth of 65 inches or more.

This soil is high in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderately slow, and runoff is medium. Tilth is good if the soil is worked under the proper moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Urban land consists of streets, single and multiunit dwellings, driveways, business buildings, schools, churches, airports, and parking lots.

Included in mapping are small areas of Bethany, Kirkland, Renfrow, and Teller soils that have been altered by cutting, grading, and filling. Bethany and Kirkland soils are on broad, nearly level ridgetops. Renfrow soils are on side slopes, and Teller soils are on lower sides slopes adjacent to local stream channels. These included soils make up about 30 percent of the map unit.

Areas of this complex are used mostly for residential, business, and industrial uses.

The potential of this complex for most urban and recreational uses ranges from low to high. The moderate permeability, shrinking and swelling, and slope are the main limitations, but they can be easily overcome. Where central sewage is not available, septic tank absorption fields will function if properly designed and installed. Slope moderately limits use for playgrounds.

This complex is not assigned to a capability subclass or range site.

17—Eufaula-Dougherty complex, 3 to 12 percent slopes. This complex consists of gently sloping to strongly sloping soils on uplands, usually on the north side of the Cimarron River. The Eufaula soil is deep and somewhat excessively drained. The Dougherty soil is deep and well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 350 acres in size.

This complex is 50 percent Eufaula soil, 40 percent Dougherty soil, and 10 percent included soils. The Eufaula soil is on lower, convex side slopes, and the Dougherty soil is on convex ridgetops and upper side slopes.

The Eufaula soil typically has a surface layer of pale brown loamy fine sand about 11 inches thick. The subsurface layer is pink fine sand about 37 inches thick.

The subsoil extends to a depth of about 72 inches. It is reddish yellow fine sand with thin bands of light reddish brown loamy fine sand.

The Eufaula soil is low in natural fertility and organic matter content. Reaction of the surface layer ranges from strongly acid to neutral. Available water capacity is low. Permeability is rapid, and surface runoff is very slow. The root zone is deep and can be easily penetrated by plant roots.

The Dougherty soil typically has a surface layer of pale brown loamy fine sand about 14 inches thick. The subsurface layer is light brown fine sand about 18 inches thick. The subsoil extends to a depth of about 65 inches. The upper 24 inches is yellowish red fine sandy loam, and the lower 9 inches is reddish yellow loamy fine sand. The underlying material is reddish yellow loamy fine sand to a depth of 80 inches.

The Dougherty soil is low in natural fertility and organic matter content. Reaction of the surface layer is medium acid or slightly acid. Available water capacity is medium. Permeability is moderate, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Derby, Konawa, Slaughterville, and Teller soils. Derby soils are on convex dunes in slightly lower positions. Konawa and Teller soils are on broad convex ridgetops. Slaughterville soils are in positions similar to that of the Dougherty soil. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for tame pasture.

This complex is not suited to cultivated crops. The very severe hazard of erosion and steep slopes are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. The very severe hazard of erosion and steep slopes make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This complex has low potential for range. Little bluestem, big bluestem, and sand bluestem are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This complex has medium potential for windbreaks and environmental plantings. The lack of available water in the subsoil of the Eufaula soil restricts the growth and development of trees.

This complex has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Slope, seepage, and poor filtering capacity are the main limitations of the Eufaula soil. Moderate permeability, slope, and seepage are the main limitations of the Dougherty soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function in the Dougherty soils if properly designed and installed. Septic tank absorption fields will function in the Eufaula soils only if the soil is extensively modified. Onsite investigation is essential.

This complex is in capability subclass VIe and Deep Sand Savannah range site.

18—Gaddy loamy fine sand, occasionally flooded. This nearly level, sandy soil is on low, narrow flood plains along the Cimarron River. This soil is deep and somewhat excessively drained. It is subject to damaging floods at least once in 10 years. These floods occur from March through October and usually last not longer than 24 hours, although they sometimes last up to 72 hours. Individual areas are long and narrow in shape and range from 20 to 200 acres in size.

Typically, the surface layer is pale brown and light brown loamy fine sand about 13 inches thick. The upper 12 inches of the underlying material is pink fine sand, and the lower part is light brown loamy fine sand stratified with thin strata of brown fine sandy loam to a depth of 80 inches or more.

Natural fertility is medium, and organic matter content is low. Reaction of the surface layer is mildly alkaline or moderately alkaline. Available water capacity is low. Permeability is moderately rapid to rapid, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Goodnight, Gracemore, Harjo Variant, and Yahola soils. Goodnight soils are on convex dunes in slightly higher positions. Gracemore soils are in lower positions nearer the stream channel. Harjo Variant soils are in depressions. Yahola soils are in slightly higher positions away from the stream channel. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and alfalfa.

This soil has medium potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, sand bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. The flooding can make establishment of plants difficult.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. The hazard of occasional flooding is a major limitation and is difficult to overcome. Septic tank absorption fields function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIIs; Sandy Bottomland range site.

19—Gaddy-Gracemore complex, frequently flooded. This complex consists of nearly level soils on low, narrow flood plains along the Cimarron River. The Gaddy soil is deep and somewhat excessively drained. The Gracemore soil is deep and somewhat poorly drained. These soils are subject to damaging floods at least once in 2 years. These floods occur from March through October and may last as long as a week. Areas of these soils are so intermingled that they could not be shown at the scale of mapping. Individual areas of this complex are long and narrow in shape and range from 20 to 100 acres in size.

This complex is 50 percent Gaddy soil, 40 percent Gracemore soil, and 10 percent included soils. The Gaddy soil is in higher positions, and the Gracemore soil is in lower areas nearer the stream channel.

The Gaddy soil typically has a surface layer of reddish yellow loamy fine sand about 8 inches thick. The underlying material to a depth of 72 inches or more is reddish yellow stratified loamy fine sand that grades to fine sand.

The Gaddy soil is medium in natural fertility and low in organic matter content. Reaction of the surface layer is moderately alkaline. Available water capacity is low. Permeability is moderately rapid to rapid, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

The Gracemore soil typically has a surface layer of reddish brown fine sandy loam about 4 inches thick that is high in salt. The underlying material extends to a depth of 72 inches or more and is high in salt. The upper 22 inches is reddish yellow fine sand, the next 8 inches is reddish brown stratified fine sandy loam, and the lower 38 inches is very pale brown stratified fine sand.

The Gracemore soil is medium in natural fertility and low in organic matter content. Reaction of the surface layer is mildly alkaline or moderately alkaline. Available water capacity is high. An apparent water table is 6 to 36 inches below the surface during most of the year. Permeability is moderately rapid to rapid, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Harjo Variant and Yahola soils. Harjo Variant soils are in depressions. Yahola soils are in slightly higher positions away from the stream channel. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for tame pasture.

This complex is not suited to cultivated crops. The flooding is very difficult to overcome.

Potential for tame pasture and hay is low. The frequent flooding may make establishment of improved grasses difficult. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to these soils. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have medium potential for range. Sand bluestem, indiangrass, eastern gamagrass, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium to high potential for windbreaks and environmental plantings. The flooding can make establishment of plants difficult.

These soils have medium potential for openland and rangeland wildlife habitat and medium potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, wild herbaceous plants, and wetland plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is low. The hazard of flooding is a major limitation and is difficult to overcome. Onsite investigation is essential.

This complex is in capability subclass Vw. The Gaddy soil is in Sandy Bottomland range site, and the

Gracemore soil is in Subirrigated (moderately saline) range site.

20—Slaughterville fine sandy loam, 3 to 6 percent slopes. This gently sloping to sloping, loamy soil is on broad convex to concave ridgetops and side slopes on uplands on the north side of the Cimarron River. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 72 inches. The upper 30 inches is brown fine sandy loam, and the lower 34 inches is reddish yellow fine sandy loam.

Natural fertility and organic matter content are medium. Reaction of the surface layer is neutral. Available water capacity is high. Permeability is moderately rapid, and surface runoff is slow to medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Derby, Dougherty, Konawa, and Minco soils. Derby soils are on dunes intermingled with this Slaughterville soil. Dougherty and Konawa soils are on higher convex ridgetops and side slopes. Minco soils are on higher side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Slaughterville soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and grain sorghum.

This soil has low to medium potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and sideoats grama are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Seepage and slope are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Sandy Prairie range site.

21—Kirkland silt loam, 0 to 2 percent slopes. This nearly level to very gently sloping, loamy soil is on broad, slightly concave ridgetops on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown silt loam about 9 inches thick. The subsoil extends to a depth of about 90 inches. The upper 25 inches is dark brown silty clay, the next 29 inches is brown silty clay, the next 15 inches is yellowish red silty clay, and the lower 12 inches is red clay.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is very slow, and surface runoff is slow. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Bethany, Doolin, Norge, and Renfrow soils. Bethany soils are on slightly convex ridgetops. Doolin soils are in positions similar to that of the Kirkland soil. Norge soils are on slightly convex ridgetops and side slopes. Renfrow soils are on slightly convex side slopes above the Kirkland soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Kirkland soil are used for crops. The principal crops are wheat and grain sorghum.

This soil has medium to high potential for crops. Small grains, row crops, and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to low potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and very slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Claypan Prairie range site.

22—Konawa fine sandy loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on narrow, convex ridge crests and side slopes on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is light brown fine sandy loam about 12 inches thick. The subsoil extends to a depth of about 60 inches. The upper 20 inches is reddish brown sandy clay loam, and the lower 24 inches is reddish brown fine sandy loam.

Natural fertility is medium to low, and organic matter content is medium. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Dougherty and Teller soils. Dougherty soils are on convex side slopes in lower positions. Teller soil are generally on ridge crests in higher positions. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Konawa soil are used for tame pasture. Where the soil is cultivated, the principal crops are wheat, grain sorghum, and peanuts.

This soil has medium potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Sandy Savannah range site.

23—Konawa loamy fine sand, 3 to 8 percent slopes. This gently sloping to sloping, sandy soil is on narrow, convex ridgetops and side slopes on uplands along the north side of the Cimarron River. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is brown loamy fine sand about 5 inches thick. The subsurface layer is light brown loamy fine sand about 4 inches thick. The subsoil extends to a depth of about 65 inches. The upper 33 inches is red sandy clay loam, and the lower 23 inches is light red fine sandy loam.

Natural fertility is low to medium and organic matter content is medium. Reaction of the surface layer is slightly acid or neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Dougherty, Eufaula, and Teller soils. Dougherty soils are on convex side slopes in lower positions. Eufaula soils are on toe slopes near drainageways. Teller soils are on ridge crests in higher positions. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Konawa soil are used for range or tame pasture. Where the soil is cultivated, the principal crops are wheat and peanuts.

This soil has low potential for crops. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem and big bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability, seepage, and slope are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IVe; Deep Sand Savannah range site.

24—Konawa fine sandy loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, slightly convex ridgetops on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsurface layer is light reddish brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 72 inches. The upper 36 inches is red sandy clay loam, and the lower 19 inches is red fine sandy loam.

Natural fertility is low to medium and organic matter content is medium. Reaction of the surface layer ranges from strongly acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Dougherty, Navina, and Teller soils. Dougherty soils are on lower convex side slopes below the Konawa soil. Navina soils are on slightly convex ridgetops above the Konawa soil. Teller soils are generally on slightly convex ridgetops above the Konawa soils. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Konawa soil are used for crops. The principal crops are wheat, peanuts, and alfalfa.

This soil has high potential for crops. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Sandy Savannah range site.

25—Grainola-Lucien complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping soils on broad, convex ridgetops and side slopes on uplands. The Grainola soil is moderately deep and well drained. The Lucien soil is shallow and well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 200 acres in size.

This complex is 50 percent Grainola soil, 30 percent Lucien soil, and 20 percent included soils. The Grainola soil is on convex side slopes, and the Lucien soil is on narrow, convex ridgetops and upper side slopes.

The Grainola soil typically has a surface layer of reddish brown loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. The upper 8 inches is reddish brown silty clay loam, and the lower 24 inches is red silty clay loam. The underlying material is dark red shale.

The Grainola soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from neutral to moderately alkaline. Available water capacity is medium. Permeability is slow, and surface runoff is medium. Tilth is good, but the soil should not be worked when wet. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

The Lucien soil typically has a surface layer of reddish brown fine sandy loam about 7 inches thick. The subsoil extends to a depth of about 15 inches. It is reddish brown fine sandy loam. The underlying material is red sandstone.

The Lucien soil is high in natural fertility and organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is shallow and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Coyle, Darnell, Huska, Masham, Mulhall, Renfrow, and Zaneis soils. Coyle and Zaneis soils are on convex ridgetops and side slopes above the Grainola and Lucien soils. Darnell soils are in positions similar to that of the Lucien soil. Huska soils are on slightly concave ridgetops above the Grainola and Lucien soils. Masham soils are on steeper side slopes. Mulhall soils are on smooth side slopes below the Grainola and Lucien soils. Renfrow soils are in positions similar to that of the Grainola soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

These soils have low potential for crops. Small grains, and vegetables are suited. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soils in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low potential for windbreaks and environmental plantings. The dense clay subsoil of the Grainola soil restricts root growth of many of the plants that can be established on this soil. The shallow depth to rock and lack of available water in the subsoil of the Lucien soil restricts the growth and development of trees.

This complex has medium potential for openland and rangeland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Shrinking and swelling, slow permeability, and depth to rock are the main limitations of the Grainola soil. Seepage and depth to rock are the main limitations of the Lucien soil. Septic tank absorption fields function poorly in the Grainola soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Lucien soil only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass IVe and Shallow Prairie range site.

26—Grainola-Lucien complex, 5 to 12 percent slopes. This complex consists of sloping to strongly sloping soils on broad, convex side slopes on uplands. The Grainola soil is moderately deep and well drained. The Lucien soil is deep and well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 20 to 350 acres in size.

This complex is 50 percent Grainola soil, 30 percent Lucien soil, and 20 percent included soils. The Grainola soil is on convex side slopes, and the Lucien soil is on convex, upper side slopes and ridgetops. Sandstone boulders cover 15 to 35 percent of the surface of the Grainola soil.

The Grainola soil typically has a surface layer of reddish brown bouldery clay loam about 3 inches thick. The subsoil is reddish brown silty clay to a depth of about 36 inches. The underlying material is reddish brown shale.

The Grainola soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from neutral to moderately alkaline. Available water capacity is medium. Permeability is slow, and surface runoff is rapid. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

The Lucien soil typically has a surface layer of reddish brown fine sandy loam about 4 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 11 inches. The underlying material is reddish brown sandstone.

The Lucien soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is medium to rapid. The root zone is shallow and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Ashport, Coyle, Darnell, Masham, and Renfrow soils. Ashport soils are below the other soils on low, narrow, nearly level flood plains along drainage channels. Coyle soils are on convex ridgetops. Darnell soils are in positions similar to that of the Lucien soil. Masham soils are on steep, convex side slopes. Renfrow soils are on lower, convex, gently sloping side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range.

These soils are not suited to cultivated crops or to tame pasture and hay. The very severe hazard of erosion, steep slopes, boulders on the surface, and shallow depth to bedrock are limitations that are very difficult to overcome.

These soils have medium potential for range (fig. 9). Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low potential for windbreaks and environmental plantings. The dense subsoil of the Grainola soil restricts root growth of many of the plants that can be established on this soil. The shallow depth of the Lucien soil restricts root development, and the lack of available water in the subsoil of the Lucien soil restricts the growth and development of trees.

These soils have medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Shrinking and swelling, slow permeability, slope, and depth to rock are the main limitations of the Grainola soil. Slope, seepage, and depth to rock are the main limitations of the Lucien soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function poorly in the Grainola soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Lucien soil only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIIs and Shallow Prairie range site.

27—Asher silty clay loam, rarely flooded. This nearly level, loamy soil is on high, narrow flood plains along the Cimarron River. This soil is deep and moderately well drained. It is subject to damaging floods once in more than 20 years. These floods occur from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark reddish gray silty clay loam about 11 inches thick. The subsoil extends to a depth of about 22 inches; it is reddish brown silty clay loam. The upper 20 inches of the underlying material is reddish brown stratified fine sandy loam and loam, and the lower part is light reddish brown stratified fine sandy loam, very fine sandy loam, loam, and silty clay loam extending to a depth of 80 inches or more.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is slow, and surface runoff is slow. Tilth is poor, and surface drainage is often a problem. The root zone is deep but roots have difficulty penetrating dense subsoil.

Included with this soil in mapping are small areas of Canadian, Dale, and Hawley soils. Canadian, Dale, and Hawley soils are in slightly higher positions nearer the river. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Figure 9.—Native grass range on Grainola-Lucien complex, 5 to 12 percent slopes. The bouldery surface is typical of the Grainola soil.

Most areas of this Asher soil are used for crops. The principal crops are alfalfa, wheat, and grain sorghum.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversion of water from higher areas helps to prevent water erosion, and surface drainage helps to remove ponded water.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing,

timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict choice of plants on their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The hazard of rare flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability class I; Loamy Bottomland range site.

28—Harjo Variant clay, ponded. This nearly level, clayey soil is in depressional areas on low flood plains along the Cimarron River. This soil is deep and somewhat poorly drained. It is subject to damaging floods at least once in 10 years. These floods occur from March through October and usually last not longer than 24 hours, although many areas are ponded for periods up to 72 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown clay about 8 inches thick. The subsoil is reddish brown clay to a depth of about 30 inches. The underlying material to a depth of 72 inches or more is light brown and pink fine sand stratified with reddish yellow loamy fine sand.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from neutral to moderately alkaline. Available water capacity is high. Permeability is very slow, and surface runoff is ponded. An apparent water table is above the soil surface or within a depth of 4-1/2 feet in winter and spring. Tilth is poor, and surface drainage is often a problem. The root zone is deep but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Gaddy, Goodnight, Gracemore, and Yahola soils. Gaddy and Yahola soils are in slightly higher positions. Goodnight soils are on convex dunes. Gracemore soils are in slightly lower positions nearer the stream channel. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Harjo Variant soil are used for tame pasture or crops. The principal crop is wheat.

This soil has low potential for crops. Small grains are suited to this soil. Removing ponded water and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversion terraces help to control water from higher areas.

Potential for tame pasture and hay is low. Bermudagrass, tall fescue, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. The dense clay subsoil restricts root growth of many of the plants that can be established on this soil. Flooding can make establishment of plants difficult.

This soil has medium potential for openland, rangeland, and wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low. Shrinking and swelling and wetness can be overcome by proper design or soil modification. Ponding and the hazard of flooding are major limitations and are difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IVw; Heavy Bottomland range site.

29—Minco very fine sandy loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, convex ridgetops and side slopes on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown very fine sandy loam about 18 inches thick. The subsoil extends to a depth of about 72 inches. The upper 30 inches is reddish brown very fine sandy loam, and the lower 24 inches is brown very fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Norge, Slaughterville, and Teller soils. Norge soils are on higher, convex ridgetops. Slaughterville soils are on lower, convex side slopes. Teller soils are generally on convex ridgetops in slightly higher positions. Also included are soils that are similar to Minco soils but that are underlain by sandstone within 40 inches of the surface. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Minco soil are used for crops. The principal crops are wheat, grain sorghum, and peanuts.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are well suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is medium to high. Seepage and moderate permeability are the major limitations. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

30—Minco very fine sandy loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on broad convex side slopes on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is brown very fine sandy loam about 18 inches thick. The subsoil extends to a depth of about 80 inches. The upper 12 inches is brown very fine sandy loam, and the lower 50 inches is reddish brown very fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Norge, Slaughterville, and Teller soils. Norge soils are on higher, convex ridgetops. Slaughterville soils are on convex side slopes in lower positions. Teller soils are on convex side slopes in higher positions. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Minco soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and grain sorghum.

This soil has medium to high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hayland is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is medium to high. Seepage, slope, and moderate permeability are the major limitations. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

31—Harrah fine sandy loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on narrow side slopes on uplands in central and western Payne County. It is deep and well drained. Individual areas are long and narrow in shape and range from 10 to 50 acres in size.

Typically, the surface layer is reddish brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 80 inches. The upper 48 inches is red fine sandy loam, and the lower 24 inches is red sandy clay loam.

Natural fertility is low to medium, and organic matter content is medium. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Darnell, Mulhall, and Stephenville soils. Darnell and Stephenville soils are on convex ridgetops and side slopes above the Harrah soil. Mulhall soils are in positions similar to that of the Harrah soil. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Harrah soil are used for tame pasture or range. Where the soil is cultivated, the principal crops are wheat and grain sorghum.

This soil has medium potential for crops, but the size and shape of areas limit such use. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem and big bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is moderate to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Sandy Savannah range site.

32—Harrah-Pulaski complex, 0 to 8 percent slopes. This complex consists of nearly level to sloping soils on forested upland drainageways in the central and western parts of Payne County. The Harrah and the Pulaski soils are deep, well drained, and loamy. The Pulaski soil is subject to damaging floods at least once in 2 years. These floods occur from March through October and last less than 24 hours. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are long and narrow in shape and range from 10 to 150 acres in size.

This complex is 45 percent Harrah soil, 30 percent Pulaski soil, and 25 percent included soils. The Harrah soil is on smooth, narrow side slopes above the Pulaski soils, which are on low, narrow flood plains along the channel.

The Harrah soil typically has a surface layer of dark reddish gray fine sandy loam about 4 inches thick. The subsurface layer is reddish brown fine sandy loam about 3 inches thick. The subsoil extends to a depth of about 80 inches. It is red sandy clay loam.

The Harrah soil is low to medium in natural fertility and medium in organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. The root zone is deep and can be easily penetrated by plant roots.

The Pulaski soil typically has a surface layer of reddish brown fine sandy loam about 3 inches thick. The underlying material extends to a depth of 72 inches or more. The upper 19 inches is yellowish red fine sandy loam, and the lower 50 inches is yellowish red stratified fine sandy loam.

The Pulaski soil is low to medium in natural fertility and low in organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is medium. Permeability is moderately rapid, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Darnell, Easpur, Mulhall, and Stephenville soils. Darnell and Stephenville soils are on convex ridgetops and side slopes above the Harrah soil. Easpur soils are in positions similar to that of the Pulaski soil. Mulhall soils are in positions similar to that of the Harrah soil. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for improved pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion, steep slopes, and the hazard of flooding are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. The frequent flooding, very severe hazard of erosion, and steep slopes make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass and other adapted improved grasses and legumes are suited to these soils. Weeping lovegrass and Caucasian and plains bluestem are suited to the Harrah soil. Preventing, overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium to high potential for windbreaks and environmental plantings. Flooding on the Pulaski soil can make establishment of plants difficult.

These soils have high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability, slope, and seepage are the main limitations of the Harrah soil. These limitations can usually be overcome by proper design or soil modification. The hazard of flooding on the Pulaski soil is a major limitation and is difficult to overcome. Septic tank absorption fields function well in the Harrah soil if properly designed and installed. Septic tank absorption fields will function in the Pulaski soil only if the soil is extensively modified. Onsite investigation is essential.

This complex is in capability subclass VIe. The Harrah soil is in Sandy Savannah range site, and the Pulaski soil is in Loamy Bottomland range site.

33—Norge loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, slightly convex ridgetops on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is reddish brown loam about 10 inches thick. The subsoil extends to a depth of about 64 inches. The upper 14 inches is reddish brown silty clay loam, the next 18 inches is yellowish red silty clay loam, and the lower 22 inches is reddish brown clay loam. The underlying material to a depth of 84 inches is red clay loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is slow. Tilth is good, but the soil should not be worked when too wet. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Bethany, Renfrow, and Teller soils. Agra soils are in slightly higher positions in the eastern part of Payne County. Bethany soils are in higher, slightly concave positions. Renfrow soils are on higher, convex side slopes. Teller soils are on lower, convex side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Norge soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high (fig. 10). Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and moderately slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption

Figure 10.—Cattle grazing well managed bermudagrass pasture on Norge loam, 1 to 3 percent slopes.

fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

34—Norge loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on broad, convex side slopes on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is reddish brown loam about 9 inches thick. The subsoil extends to a depth of about 66 inches. The upper 5 inches is reddish brown silt loam, the next 22 inches is red silty clay loam, the next 9 inches is reddish brown silty clay loam, and the lower 21 inches is yellowish red silty clay loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is medium. Tilth is good, but the soil should not be worked when wet. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Mulhall, Renfrow, Teller, and Zaneis soils. Agra soils are on convex, upper side slopes in the eastern part of Payne County. Mulhall soils are on linear, upper side slopes. Renfrow soils are on convex, upper side slopes in the central and western parts of Payne County. Teller soils are on lower side slopes. Zaneis soils are on convex, upper side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Norge soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has medium potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in soil management. A planned system of fertilizaton, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments range from low to high. Shrinking and swelling, slope, and moderately slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

35—Norge loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping, loamy soil is on broad, slightly convex ridgetops and side slopes on eroded uplands. It is deep and well drained. This soil has been cultivated in the past, and water erosion has removed much of the surface layer leaving the subsoil exposed in much of the area. Rills and shallow gullies that can be crossed with farm machinery are common. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil extends to a depth of about 80 inches. The upper 3 inches is reddish brown silt loam, and the lower 67 inches is yellowish red silty clay loam.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Mulhall, Renfrow, Teller and Zaneis soils. Agra soils are on convex, upper side slopes in the eastern part of Payne County. Mulhall soils are on linear, upper side slopes. Renfrow soils are on convex, upper side slopes in the central and western parts of Payne County. Teller soils are on lower side slopes. Zaneis soils are on convex, upper side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has low potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, slope, and moderately slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

36—McLain silt loam, rarely flooded. This nearly level, loamy soil is on high narrow, linear flood plains of major tributaries mainly in the northern part of Payne County. This soil is deep and moderately well drained. It is subject to damaging floods once in more than 20 years. These floods occur from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 5 to 100 acres in size.

Typically, the surface layer is brown silt loam about 18 inches thick. The subsoil extends to a depth of about 80 inches. The upper 11 inches is dark reddish gray silty clay loam, the next 39 inches is reddish brown silty clay loam, and the lower 12 inches is yellowish red silty clay loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is neutral or mildly alkaline. Available water capacity is high. Permeability is slow, and surface runoff is slow. Tilth is good, but the soil should not be worked when wet. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Dale and Port soils. Dale soils are in positions similar to that of the McLain soil and are intermingled with it. Port soils are in slightly lower positions below the McLain soil. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this McLain soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversions help to protect this soil from erosion by water from higher areas.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and slow permeability are limitations, but they can be overcome by proper design or soil modification. The hazard of rare flooding is a major limitation and is difficult to overcome. Septic tank absorption fields function poorly, and sewage lagoons will function properly in this soil only if the soil is modified somewhat. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability class I; Loamy Bottomland range site.

37—Port silt loam, occasionally flooded. This nearly level, loamy soil is on low, narrow flood plains along major tributaries. It is deep and well drained. This soil is subject to damaging floods usually once in 10 to 20 years. These floods occur mainly from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown and dark reddish gray silt loam about 29 inches thick. The subsoil extends to a depth of about 80 inches. The upper 15 inches is reddish brown silt loam, and the lower 36 inches is yellowish red loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, but the soil should not be worked when wet. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Asport, Dale, Easpur, Gowen, Oscar, and Pulaski soils. Ashport soils are in lower, slightly concave areas. Dale soils are on higher parts of the flood plain. Easpur and Pulaski soils are in lower positions nearer to the channel. Gowen and Oscar soils are in positions similar to that of the Port soil and are intermingled with it. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Port soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops (fig. 11). Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversion terraces help to prevent damage by water from higher areas.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth, but flooding can make establishment difficult.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. The moderate permeability is a limitation, but it can be overcome by proper design or soil modification. The hazard of occasional flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIw; Loamy Bottomland range site.

38—Navina loam, 0 to 1 percent slopes. This nearly level, loamy soil is on broad, slightly convex ridgetops on uplands. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 600 acres in size.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil extends to a depth of about 60 inches. The upper 14 inches is brown loam, the next 7 inches is brown sandy clay loam, and the lower 29 inches is reddish yellow fine sandy loam. The underlying material to a depth of 80 inches is reddish yellow loamy fine sand and fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth

Figure 11.—Forage sorghum being cut for silage on Port silt loam, occasionally flooded.

is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Bethany, Konawa, Norge, and Teller soils. Bethany soils are in higher, slightly concave positions. Konawa soils are in lower positions. Norge soils are in higher, slightly convex positions. Teller soils are in positions similar to that of the Navina soil and are intermingled with it. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Navina soil are used for crops. The principal crops are wheat, alfalfa, and peanuts.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability class I; Loamy Prairie range site.

39—Port-Oscar complex, occasionally flooded. This complex consists of nearly level soils on low, narrow flood plains at the upper ends of Long Branch and Stillwater Creeks. These soils are subject to damaging floods usually once in 10 to 20 years. These floods occur mainly from March through August and last not longer than 24 hours. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are long and narrow in shape and range from 10 to 100 acres in size.

This complex is 60 percent Port soil, 25 percent Oscar soil, and 15 percent included soils.

The Port soil typically has a surface layer of reddish brown silt loam about 26 inches thick. The subsoil extends to a depth of about 80 inches. The upper 36 inches is reddish brown silty clay loam, and the lower 18 inches is reddish brown silt loam.

The Port soil is high in natural fertility and organic matter content. Reaction of the surface layer ranges from neutral to mildly alkaline. Available water capacity is high. Permeability is moderate, and runoff is slow. Tilth is good, but the soil should not be worked when too wet. The root zone is deep and can be easily penetrated by plant roots.

The Oscar soil typically has a surface layer of reddish brown silt loam about 9 inches thick. The subsoil extends to a depth of about 65 inches. The upper 23 inches is dark reddish gray silty clay loam, and the lower 33 inches is reddish brown silty clay loam. The underlying material to a depth of 74 inches or more is reddish yellow silt loam.

The Oscar soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from slightly acid to mildly alkaline. The subsoil is high in sodium and soluble salts. Available water capacity is low. Permeability is slow, and surface runoff is slow. Tilth is poor, and surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense clay subsoil.

Included with these soils in mapping are small areas of Ashport, Dale, Easpur, Gowen, and Pulaski soils. Ashport soils are in lower, slightly concave positions. Easpur and Pulaski soils are in lower positions nearer to the channel. Gowen soils are in positions similar to those of the Port and Oscar soils and are intermingled with them. Dale soils are on higher parts of the flood plain. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for crops or tame pasture. The principal crops are wheat, alfalfa, and grain sorghum.

This complex has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to these soils. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, application of gypsum, and residue management help to maintain soil tilth and productivity.

Potential for tame pasture and hay is high. Bermudagrass and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium potential for windbreaks and environmental plantings. The dense clayey subsoil of the Oscar soil restricts root growth of many of the plants that can be established on this soil. The lack of available water in the subsoil of the Oscar soil restricts the growth and development of trees. Flooding can make establishment difficult.

These soils have medium to high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to the Port soil.

Potential for sanitary facilities, building sites, and recreational developments is low. Slow permeability and excess sodium in the Oscar soil and the hazard of flooding on both soils are limitations that are difficult to overcome. Septic tank absorption fields will function in these soils only if the soil is extensively modified. Onsite investigation is essential.

This complex is in capability subclass IVs. The Port soil is in Loamy Bottomland range site, and the Oscar soil is in Alkali Bottomland range site.

40—Grainola-Ashport complex, 0 to 8 percent slopes. This complex consists of nearly level to sloping soils on upland drainageways. The Grainola soil is moderately deep and well drained. The Ashport soil is deep and well drained. The Ashport soil is subject to damaging floods at least once in 2 years. These floods occur from March through October and last less than 24 hours. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are long and narrow in shape and range from 10 to 100 acres in size.

This complex is 45 percent Grainola soil, 30 percent Ashport soil, and 25 percent included soils. The Grainola soil is on narrow, convex side slopes, and the Ashport soil is on low, narrow flood plains below the Grainola soil.

The Grainola soil typically has a surface layer of reddish gray silt loam about 7 inches thick. The subsoil extends to a depth of about 36 inches. The upper 2 inches is reddish brown silty clay loam, and the lower 27 inches is reddish brown silty clay. The underlying material to a depth of 43 inches or more is red shale.

The Grainola soil is medium in natural fertility and organic matter content. Reaction of the surface layer is mildly alkaline or moderately alkaline. Available water capacity is medium. Permeability is slow, and surface runoff is medium to rapid. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

The Ashport soil typically has a surface layer of reddish gray silt loam about 14 inches thick. The subsoil is reddish brown silt loam to a depth of about 29 inches. The underlying material to a depth of 48 inches or more is yellowish red silt loam stratified with thin layers of loam and fine sandy loam.

The Ashport soil is high in natural fertility and organic matter content. Reaction of the surface layer is neutral or mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Coyle, Easpur, Gowen, Lucien, Masham, Mulhall, Port, Pulaski, and Renfrow soils. Coyle and Lucien soils formed in material weathered from sandstone and are in positions similar to that of the Grainola soil. Easpur, Gowen, Port, and Pulaski soils are in positions similar to that of the Ashport soil. Masham soils are on steeper side slopes between the Grainola and Ashport soils. Mulhall and Renfrow soils are on side slopes above the Grainola soil. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for improved pasture.

This complex is not suited to cultivated crops. The very severe hazard of erosion, steep slopes, and the hazard of flooding are limitations that are very difficult to overcome.

Potential for tame pasture and hay is medium. The frequent flooding of the Ashport soil and the very severe hazard of erosion and steep slopes of the Grainola soil make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass and other adapted improved grasses and legumes are suited to these soils. Caucasian and plains bluestem are suited to the Grainola soil. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This complex has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This complex has medium to high potential for windbreaks and environmental plantings. The dense subsoil of the Grainola soil restricts root growth of many of the plants that can be established on this soil. Flooding on the Ashport soil can make establishment difficult.

This complex has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, slow permeability, and depth to rock are the main limitations of the Grainola soil. These limitations can usually be overcome by proper design or soil modification. The hazard of flooding on the Ashport soil is a major limitation and is difficult to overcome. Septic tank absorption fields function poorly in the Grainola soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Ashport soil only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIe. The Grainola soil is in Shallow Prairie range site, and the Ashport soil is in Loamy Bottomland range site.

41—Easpur loam, occasionally flooded. This nearly level, loamy soil is on low, narrow flood plains along major tributaries throughout the county. This soil is deep and well drained. It is subject to damaging floods usually once in 10 to 20 years. These floods occur mainly from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown loam about 11 inches thick. The subsoil extends to a depth of about 29 inches. The upper 8 inches is reddish brown fine sandy loam, and the lower 10 inches is reddish brown clay loam. The underlying material, to a depth of 41 inches or more, is stratified reddish brown loam, yellowish red fine sandy loam, and reddish brown clay loam. Below 41 inches is a buried soil of dark reddish gray and reddish brown silty clay loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to moderately alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Ashport, Gowen, Oscar, Port, and Pulaski soils. Ashport and Oscar soils are in slightly concave, slightly lower positions further from the stream channel. Gowen and Port soils are in positions similar to that of the Easpur soil. Pulaski soils are adjacent to the stream channel. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Easpur soil are used for crops. The principal crops are wheat, alfalfa, and grain sorghum.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversions help to control water from higher areas.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. Flooding can make establishment difficult.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. The hazard of occasional flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIw; Loamy Bottomland range site.

42—Ashport silty clay loam, occasionally flooded. This nearly level, loamy soil is on low, narrow flood plains along major and minor tributaries. This soil is deep and well drained. It is subject to damaging floods usually once in 10 to 20 years. These floods occur mainly from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark reddish gray silty clay loam about 16 inches thick. The subsoil is reddish brown silty clay loam to a depth of about 36 inches. Underlying the subsoil is a buried soil that is dark reddish gray loam to a depth of 52 inches over reddish brown and yellowish red loam to a depth of 80 inches or more.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to moderately alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, but the soil should not be worked when wet. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Easpur, Gowen, Oscar, Port, and Pulaski soils. Easpur and Pulaski soils are in slightly higher positions nearer or adjacent to the stream channel. Gowen and Port soils are in positions similar to that of the Ashport soil. Oscar soils are intermingled with the Ashport soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Ashport soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water from higher areas and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversions help to control water from higher areas. Surface drainage is occasionally needed to remove ponded water.

Potential for tame pasture and hay is high (fig. 12). Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth, but flooding can make establishment difficult.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Figure 12.—Bermudagrass hay has been harvested from this area of Ashport silty clay loam, occasionally flooded. Surface drainage is often needed to remove water that has run onto this soil from higher areas.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The hazard of occasional flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIw; Loamy Bottomland range site.

43—Pulaski fine sandy loam, occasionally flooded. This nearly level, loamy soil is on low, slightly convex flood plains. This soil is deep and well drained. It is subject to damaging floods usually once in 10 to 20 years. These floods occur mainly from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown fine sandy loam about 8 inches thick. The underlying material to a depth of 80 inches or more is red fine sandy loam stratified with thin strata of reddish brown loam, loamy fine sand, and very fine sandy loam.

Natural fertility is low to medium, and organic matter content is low. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is medium. Permeability is moderately rapid, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Easpur, Ashport, Port, and Tribby soils. Easpur soils are in slightly higher positions. Ashport and Port soils are in slightly concave areas away from the creek channel. Tribby soils are in lower and wetter areas. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Pulaski soil are used for crops or tame pasture. The principal crops are wheat, alfalfa, and peanuts.

This soil has high potential for crops (fig. 13). Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Diversion terraces help to prevent damage by water from higher areas.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth, but flooding can make establishment difficult.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Seepage is the main limitation, but it can be overcome by proper design or soil modification. The hazard of occasional flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIw; Loamy Bottomland range site.

44—Canadian fine sandy loam, rarely flooded. This nearly level, loamy soil is on high, narrow flood plains along the Cimarron River. It is subject to damaging floods once in more than 20 years. These floods occur from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown and dark brown fine sandy loam about 22 inches thick. The subsoil is brown fine sandy loam to a depth of about 48 inches. The underlying material to a depth of 72 inches or more is brown fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to mildly alkaline. Available water capacity is high. Permeability is moderately rapid, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Asher, Dale, Goodnight, and Hawley soils. Asher soils are in slightly concave areas farther from the river. Dale

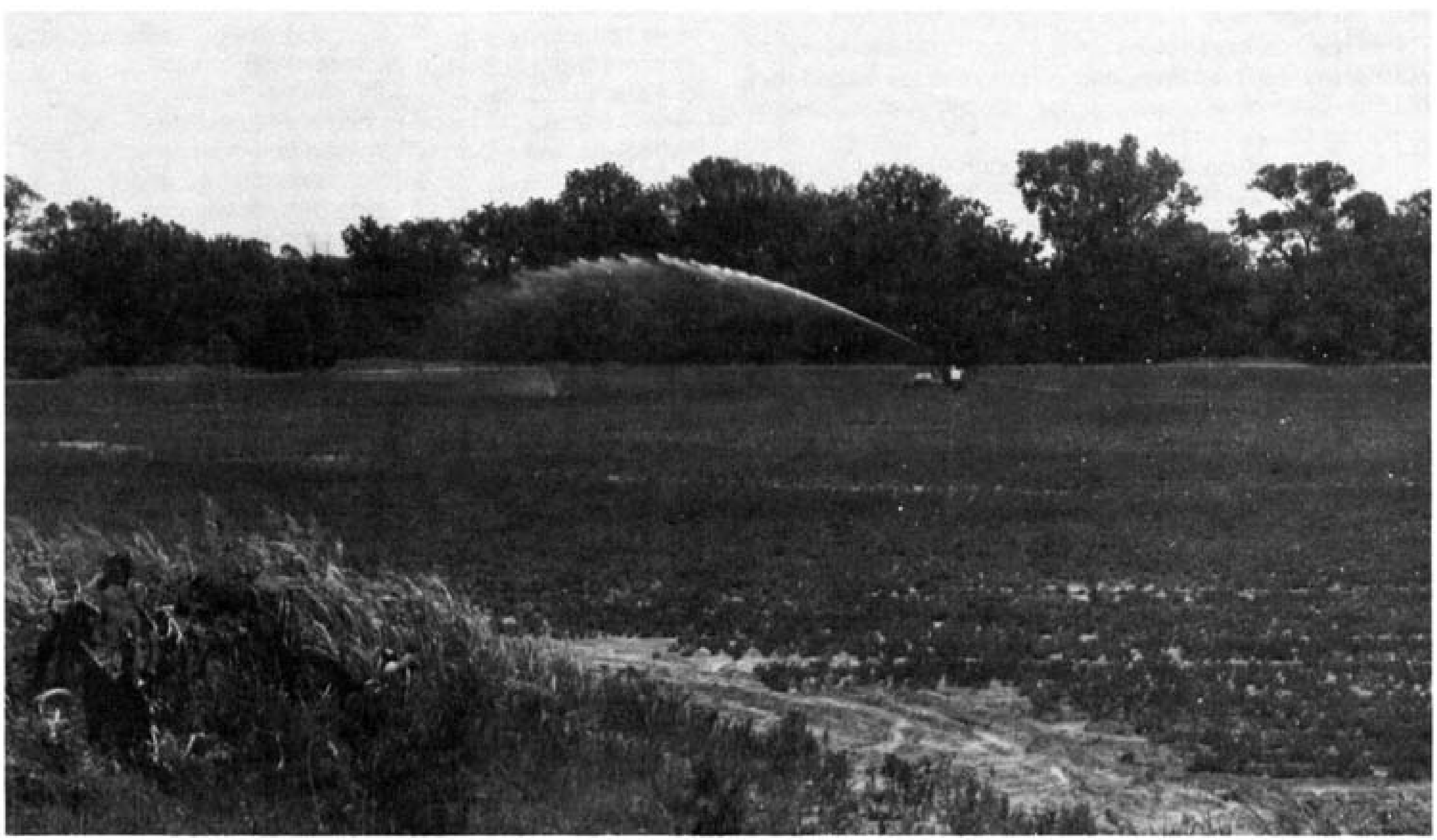


Figure 13.—Irrigation of peanuts on Pulaski fine sandy loam, occasionally flooded.

soils are in positions similar to that of the Canadian soil. Goodnight soils are on convex dunes nearer the river. Hawley soils are in slightly lower positions nearer the river. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Canadian soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The rare hazard of flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function properly only if the soil is extensively modified. Onsite investigation is essential.

Capability class I; Loamy Bottomland range site.

45—Renfrow silt loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, convex upland ridgetops and side slopes in the central and western parts of Payne County. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsoil extends to a depth of about 80 inches. The upper 16 inches is reddish brown silty clay loam, the next 15 inches is reddish brown clay, and the lower 40 inches is red clay.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is very slow, and surface runoff is medium. Tilth is good, but the soil should not be worked when wet. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Bethany, Coyle, Grainola, Huska, Kirkland, and Zaneis soils. Bethany soils are on lower side slopes. Coyle soils are on convex ridge crests. Grainola soils are on convex upper side slopes. Huska soils are on slightly concave side slopes at heads of drainageways. Kirkland soils are in higher positions. Zaneis soils are on convex ridge crests. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Renfrow soil are used for crops or range. The principal crops are wheat and grain sorghum.

This soil has medium potential for crops. Small grains, row crops, and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and very slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Claypan Prairie range site.

46—Renfrow silt loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on broad, convex side slopes on uplands in the central and western parts of Payne County. This soil is deep and well drained. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark reddish gray silt loam about 10 inches thick. The subsoil extends to a depth of about 66 inches. The upper 5 inches is reddish brown silty clay loam, the next 15 inches is reddish brown silty clay, the next 12 inches is yellowish red silty clay, and the lower 24 inches is red silty clay.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is very slow, and surface runoff is medium. Tilth is good, but the soil should not be worked when too wet. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Coyle, Grainola, Huska, Mulhall, Norge, and Zaneis soils. Coyle, Grainola, and Zaneis soils are on convex upper side slopes. Huska soils are on lower, slightly concave side slopes. Mulhall soils are on linear upper side slopes. Norge soils are on convex lower side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Renfrow soil are used for crops or range. The principal crop is wheat.

This soil has low potential for crops. Small grains, row crops, and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and very slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVe; Claypan Prairie range site.

47—Renfrow loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping, loamy soil is on broad, convex side slopes on eroded uplands in the central and western parts of Payne County. This soil is deep and well drained. This soil has been cultivated in the past, and water erosion has removed much of the surface layer leaving the subsoil exposed in more than half of the area. Rills and shallow gullies that can be crossed with farm machinery are common. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is reddish brown loam about 6 inches thick. The subsoil extends to a depth of about 72 inches. The upper 29 inches is reddish brown silty clay, and the lower 37 inches is red silty clay.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from slightly acid to neutral. Available water capacity is high. Permeability is very slow, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Coyle, Grainola, Huska, Kirkland, Mulhall, and Zaneis soils. Coyle soils are on convex ridge crests. Grainola and Zaneis soils are on convex upper side slopes. Huska soils are on slightly concave side slopes at the heads of drainageways. Kirkland soils are on broad, very slightly concave ridgetops. Mulhall soils are on upper, linear side slopes. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Renfrow soil are used for tame pasture or crops. The principal crop is wheat.

This soil has low potential for crops. Small grains, row crops, and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has low to medium potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling and very slow permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVe; Claypan Prairie range site.

48—Masham-Rock outcrop complex, 20 to 45 percent slopes. This complex consists of steep, loamy Masham soil and outcrops of sandstone on uplands mainly along the Cimarron River. The Masham soil is shallow and well drained; it formed in material weathered from silty and clayey shale between the layers of sandstone. Areas of the Masham soil and Rock outcrop are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are long and narrow in shape and range from 10 to 300 acres in size.

This complex is 60 percent Masham soil, 15 percent Rock outcrop, and 25 percent included soils.

The Masham soil typically has a surface layer of reddish brown silty clay loam about 4 inches thick. The subsoil is reddish brown silty clay to a depth of about 15 inches. The underlying material is reddish brown weathered silty shale that can be dug with a spade when moist.

This soil is medium in natural fertility and organic matter content. Reaction of the surface layer is moderately alkaline. Available water capacity is low. Permeability is very slow, and surface runoff is rapid. The root zone is shallow, and roots have difficulty penetrating the dense subsoil.

The Rock outcrop is mostly exposed layers of hard sandstone, but some limestone is found in the eastern part of Payne County. Surface runoff is very rapid.

Included in mapping are small areas of Darnell, Grainola, Lucien, and Slaughterville soils. Darnell soils are generally below the Rock outcrop. Grainola soils are on convex lower side slopes. Lucien soils are generally above the Rock outcrop. Slaughterville soils are usually near the top of the side slope, but can occur anywhere on the side slope. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range.

This complex is not suited to cultivated crops. The very severe hazard of erosion, steep slopes, outcrops of rock, and shallow depth to bedrock are limitations that are very difficult to overcome.

This complex is not suited to tame pasture and hay. The very severe hazard of erosion, steep slopes, outcrops of rock, and shallow depth to bedrock are limitations that are very difficult to overcome.

This complex has low potential for range. Little bluestem, sideoats grama, blue grama, and buffalograss are suited to the Masham soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This complex has low potential for windbreaks and environmental plantings. The dense clay subsoil, shallow depth to rock, and lack of available water in the subsoil restrict the growth and development of trees.

This complex has low potential for openland and rangeland wildlife habitat and is not suited to wetland wildlife habitat. Wild herbaceous plants are suited to the Masham soil.

Potential for sanitary facilities, building sites, and recreational developments is low. Shrinking and swelling, very slow permeability, slope, and depth to rock are the main limitations of the Masham soil. Low strength is a limitation for local roads and streets. Septic tank absorption fields function poorly in the Masham soil, and sewage lagoons are suitable only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIIe. The Masham soil is in Red Clay Prairie range site, and Rock outcrop is not assigned to a range site.

49—Renfrow and Grainola soils, 3 to 8 percent slopes, severely eroded. This group consists of gently sloping to sloping soils on broad, convex, eroded upland ridgetops and side slopes in the central and western parts of Payne County. The Renfrow soil is deep and well drained, and the Grainola soil is moderately deep and well drained. These soils have been cultivated in the past, and water erosion has removed much of the surface layer and formed many shallow gullies, sorne of which can not be crossed with farm machinery. The pattern of soils in this group is variable; some areas contain only the Renfrow soil, and other areas contain both kinds of soil. Individual areas of this group are irregular in shape and range from 10 to 200 acres in size.

This group is 45 percent Renfrow soil, 40 percent Grainola soil, and 15 percent included soils. The Renfrow soil is on ridgetops and lower, gently sloping side slopes, and the Grainola soil is on upper, sloping side slopes.

The Renfrow soil typically has a surface layer of reddish gray silt loam about 3 inches thick. The subsoil is reddish brown silty clay to a depth of about 60 inches. The underlying material to a depth of 71 inches or more is weathered red clayey shale.

The Renfrow soil is medium in natural fertility and organic matter content. Reaction of the surface layer is slightly acid. Available water capacity is high. Permeability is very slow, and surface runoff is medium. The root zone is deep, but roots have difficulty penetrating the dense clay subsoil.

The Grainola soil typically has a surface layer of reddish brown silty clay loam about 6 inches thick. The subsoil is reddish brown silty clay to a depth of about 38 inches. The underlying material to a depth of 70 inches or more is weathered red calcareous silty shale.

The Grainola soil is low in natural fertility and medium in organic matter content. Reaction of the surface layer is moderately alkaline. Available water capacity is medium. Permeability is slow, and surface runoff is medium. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

Included with these soils in mapping are small areas of Coyle, Huska, Lucien, and Zaneis soils. Coyle and Lucien soils are on convex ridge crests. Huska soils are in positions similar to those of the Renfrow and Grainola soils and are intermingled with them. Zaneis soils are on ridgetops and upper side slopes. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of these soils are used for range. A few areas are used for tame pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion is a limitation that is very difficult to overcome.

Potential for tame pasture and hayland is low. The very severe hazard of erosion makes establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have low potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low potential for windbreaks and environmental plantings. The dense clay subsoil restricts root growth of many of the plants that can be established on this soil.

These soils have low to medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is low or medium. Shrinking and swelling, very slow or slow permeability, and slope are limitations of both soils. Depth to rock is also a limitation of the Grainola soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function poorly in these soils, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIe. The Renfrow soil is in Eroded Clay range site, and the Grainola soil is in Eroded Prairie range site.

50—Mulhall-Agra complex, 2 to 5 percent slopes, gullied. This complex consists of very gently sloping to gently sloping soils on broad, convex to linear side slopes on gullied uplands in the eastern part of Payne County. The Mulhall soil is deep and well drained. The Agra soil is deep and moderately well drained. These soils have been cultivated in the past, and severe water erosion has formed gullies, most of which cannot be crossed with farm machinery. The gullies make up 7 percent of each mapped area. The soils are between the gullies. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 100 acres in size.

This complex is 45 percent Mulhall soil, 30 percent Agra soil, and 25 percent included soils. The Mulhall soil is on upper, linear side slopes, and the Agra soil is on lower, convex side slopes.

The Mulhall soil typically has a surface layer of dark brown loam about 11 inches thick. The subsoil extends to a depth of about 62 inches. The upper 5 inches is dark brown clay loam, the next 32 inches is brown clay loam, the next 8 inches is light brown clay loam, and the lower 6 inches is reddish yellow sandy clay loam.

The Mulhall soil is medium in natural fertility and high in organic matter content. Reaction of the surface layer is neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. The root zone is deep and can be easily penetrated by plant roots.

The Agra soil typically has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper 3 inches is dark brown clay loam, the next 14 inches is brown clay loam, the next 15 inches is brown clay, and the lower 20 inches is strong brown clay.

The Agra soil is medium in natural fertility and high in organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. A perched water table is within 3 to 4 feet of the surface in winter and spring. Permeability is very slow, and runoff is medium. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this complex in mapping are small areas of Coyle, Chickasha, Norge, Seminole, and Steedman soils. Coyle and Chickasha soils are on convex upper side slopes and ridge crests. Norge soils are on convex lower side slopes. Seminole soils are on concave lower side slopes. Steedman soils are on convex upper side slopes. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for tame pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion and deep gullies are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. Deep gullies make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, Caucasian and plains bluestem and other adapted improved grasses and legumes are suited to these soils. Weeping lovegrass is suited to the Mulhall soil. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have low potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low to high potential for windbreaks and environmental plantings. The dense clay subsoil of the Agra soil restricts root growth of many of the plants that can be established on this soil.

These soils have low to high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, moderate and very slow permeability, slope, and wetness are the main limitations, but they can usually be overcome by proper design or soil modification. Septic tank absorption fields function poorly in these soils, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIe. The Mulhall soil is in Eroded Prairie range site, and the Agra soil is in Eroded Clay range site.

51—Stephenville fine sandy loam, 1 to 5 percent slopes, severely eroded. This very gently sloping to gently sloping, loamy soil is on broad ridgetops and side slopes on eroded uplands. This soil is moderately deep and well drained. This soil has been cultivated, and water erosion has removed much of the surface layer. In some areas sandstone bedrock is exposed at the surface. There are many gullies, some of which can not be crossed with farm machinery. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown fine sandy loam about 4 inches thick. The subsoil extends to a depth of about 23 inches. The upper 15 inches is yellowish red fine sandy loam, and the lower 4 inches is reddish yellow fine sandy loam. The underlying material is yellowish red sandstone that is rippable when moist and hard when dry.

Natural fertility and organic matter content are low. Reaction of the surface layer is slightly acid or neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. The root zone is moderately deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Darnell, Grainola, and Harrah soils and Rock outcrop. Coyle soils are in positions similar to that of the Stephenville soil and are intermingled with it. Grainola soils are on convex upper side slopes. Darnell soils are on ridgetops and upper side slopes. Harrah soils are on slightly concave lower side slopes. Rock outcrop is in areas where the soil has been eroded completely away. Also included on convex upper side slopes are areas of a soil that is similar to Stephenville soils but that is underlain by clayey shale. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range. A few areas are used for tame pasture.

This soil is not suited to cultivated crops. The very severe hazard of erosion and shallow depth to bedrock are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. The very severe hazard of erosion and shallow depth to bedrock make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The shallow depth to rock restricts root development, and the lack of available water in the subsoil restricts the growth and development of trees.

This soil has medium to high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Depth to rock is the main limitation, but it can usually be overcome by proper design or soil modification. Septic tank absorption fields will function in this soil only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass VIe; Eroded Sandy Savannah range site.

52—Steedman-Lucien-Shidler complex, 1 to 15 percent slopes. This complex consists of very gently sloping to moderately steep soils on broad, convex ridgetops and side slopes on uplands in the eastern part of Payne County. The Steedman soil is moderately deep and moderately well drained. The Lucien soil is shallow and well drained. The Shidler soil is shallow and very shallow and is well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 300 acres in size.

This complex is 50 percent Steedman soil, 20 percent Lucien soil, 10 percent Shidler soil, and 20 percent included soils. The Steedman soil is very gently sloping to moderately steep and is on convex side slopes. The Lucien soil is very gently sloping and is on convex ridgetops and upper side slopes. The Shidler soil is very gently sloping to gently sloping and is on convex ridgetops and upper side slopes.

The Steedman soil typically has a surface layer of gray stony clay loam about 7 inches thick. The subsoil extends to a depth of about 28 inches. The upper 4 inches is grayish brown stony clay loam, the next 9 inches is light brownish gray clay, and the lower 8 inches is light yellowish brown clay. The underlying material is light yellowish brown clayey shale to a depth of 40 inches or more.

The Steedman soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from slightly acid to mildly alkaline. A perched water table is at a depth of 1/2 to 1 foot during winter and spring. Permeability is slow, and surface runoff is rapid. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

The Lucien soil typically has a surface layer of brown fine sandy loam about 7 inches thick. The subsoil is brown fine sandy loam about 7 inches thick. The underlying material is brownish yellow sandstone that is hard when dry and rippable when moist.

The Lucien soil is high in natural fertility and organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is rapid. The root zone is shallow and can be easily penetrated by plant roots.

The Shidler soil typically has a surface layer of dark gray clay loam about 7 inches thick. The subsoil extends to a depth of about 18 inches. The upper 6 inches is dark brown clay loam, and the lower 5 inches is pale brown flaggy clay loam. The underlying material is hard, light gray limestone.

The Shidler soil is high in natural fertility and organic matter content. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is low. Permeability is moderate, and surface runoff is medium to rapid. The root zone is shallow and can be easily penetrated by plant roots.

Included with this complex in mapping are small areas of Agra, Coyle, Darnell, Grainola, Gowen, Mulhall, and Norge soils. Agra soils are on gently sloping lower side slopes. Coyle soils are on convex ridge crests and upper side slopes. Darnell and Norge soils are on ridgetops. Grainola soils are on convex side slopes. Gowen soils are in nearly level areas adjacent to small drainageways. Mulhall soils are on lower side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range.

These soils are not suited to cultivated crops. The steep slopes, stones on the surface, and shallow depth to bedrock are limitations that are very difficult to overcome.

These soils are not suited to tame pasture and hay. The very severe hazard of erosion, steep slopes, stones on the surface, and shallow depth to bedrock are limitations that are very difficult to overcome.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, switchgrass, sideoats grama, and hairy grama are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low to medium potential for windbreaks and environmental plantings. The dense subsoil of the Steedman soil restricts root growth of many of the plants that can be established on this soil. The shallow depth to rock of the Lucien and Shidler soils also restricts root development.

These soils have medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is low. Shrinking and swelling, slow permeability, wetness, stones, slope, and depth to rock are the main limitations of the Steedman soil. Seepage and depth to rock are the main limitations of the Lucien soil. Depth to rock is the main limitation of the Shidler soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function poorly in the Steedman soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Lucien and Shidler soils only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIIs. The Steedman soil is in Loamy Prairie range site, the Lucien soil is in Shallow Prairie range site, and the Shidler soil is in Very Shallow range site.

53—Stephenville fine sandy loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, convex ridgetops on uplands. This soil is moderately deep and well drained. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 7 inches thick. The subsurface layer is light brown fine sandy loam about 5 inches thick. The subsoil is yellowish red sandy clay loam to a depth of about 22 inches. The underlying material is yellowish red sandstone that is rippable when moist and hard when dry.

Natural fertility is low to medium and organic matter content is medium. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is moderately deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Darnell, Coyle, Grainola, and Harrah soils. Darnell soils are in positions similar to that of the Stephenville soil and are intermingled with it. Grainola soils are on lower convex slopes. Coyle soils are in positions similar to that of the Stephenville soil. Harrah soils are on lower side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Stephenville soil are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

This soil has low to medium potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Depth to rock is the main limitation, but it can be overcome by proper design or soil modification. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIe; Sandy Savannah range site.

54—Stephenville fine sandy loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on broad, convex side slopes on uplands. It is moderately deep and well drained. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is reddish brown fine sandy loam about 5 inches thick. The subsurface layer is light reddish brown fine sandy loam about 10 inches thick. The subsoil is yellowish red and reddish yellow sandy clay loam to a depth of about 32 inches. The underlying material is red sandstone that is rippable when moist and hard when dry.

Natural fertility is low to medium and organic matter content is medium. Reaction of the surface layer ranges from strongly acid to neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is moderately deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Darnell, Grainola, and Harrah soils. Coyle soils are in positions similar to that of the Stephenville soil. Darnell soils generally are on upper side slopes. Grainola soils are on convex side slopes. Harrah soils are on lower side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Stephenville soil are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

This soil has low potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Depth to rock is the main limitation, but it can be overcome by proper design or soil modification. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIIe; Sandy Savannah range site.

55—Teller loam, 0 to 1 percent slopes. This nearly level, loamy soil is on broad, slightly convex ridgetops on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 20 to 200 acres in size.

Typically, the surface layer is dark brown loam about 12 inches thick. The subsoil extends to a depth of about 60 inches. The upper 22 inches is reddish brown clay loam, the next 10 inches is red sandy clay loam, and the lower 6 inches is red fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is medium acid or slightly acid. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Konawa, Minco, Navina, and Norge soils. Konawa and Minco soils are in lower positions. Norge soils are in very slightly higher positions. Navina soils are in positions similar to that of the Teller soil and are intermingled with it. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Teller soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing,

timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modificiation. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability class I; Loamy Prairie range site.

56—Teller fine sandy loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, slightly convex ridgetops on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 15 inches thick. The subsoil extends to a depth of about 60 inches. The upper 5 inches is brown fine sandy loam, the next 22 inches is yellowish red sandy clay loam, and the lower 18 inches is yellowish red fine sandy loam. The underlying material to a depth of 70 inches or more is yellowish red fine sandy loam.

Natural fertility and organic matter content is high. Reaction of the surface layer is medium acid or slightly acid. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Dougherty, Konawa, Minco, Navina, and Slaughterville soils. Dougherty soils are on lower side slopes. Konawa soils are in positions similar to that of the Teller soil and are intermingled with it. Minco soils are in higher, slightly convex positions. Navina soils are in higher, nearly level areas. Slaughterville soils are on lower side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Teller soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has medium to high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

57—Teller loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, slightly convex ridgetops on uplands. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown loam about 13 inches thick. The subsoil extends to a depth of about 80 inches. The upper 8 inches is reddish brown loam, the next 14 inches is yellowish red clay loam, the next 25 inches is red clay loam, and the lower 20 inches is red fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is medium acid or slightly acid. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Konawa, Minco, Navina, and Norge soils. Konawa soils are on lower side slopes. Minco soils are on upper side slopes. Navina soils are in positions similar to that of the Teller soil and are intermingled with it. Norge soils are in slightly higher positions. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Teller soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has medium to high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

58—Teller loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on narrow, convex side slopes on uplands. It is deep and well drained. Individual areas are long and narrow in shape and range from 5 to 50 acres in size.

Typically, the surface layer is reddish brown loam about 10 inches thick. The subsoil extends to a depth of about 72 inches. The upper 5 inches is reddish brown loam, the next 28 inches is red clay loam, and the lower 29 inches is red loam to a depth of 72 inches.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderate and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Konawa, Minco, and Norge soils. Konawa soils are on lower side slopes. Minco and Norge soils are on upper side slopes. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Teller soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has medium potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

59—Konawa and Teller soils, 2 to 6 percent slopes, eroded. This group consists of very gently sloping to sloping soils on broad, convex ridge crests and side slopes on uplands. The Konawa soil is deep, well drained, and sandy. The Teller soil is deep, well drained, and loamy. These soils have been cultivated in the past, and water erosion has removed much of the surface layer leaving the subsoil exposed over much of the area. Rills and shallow gullies that can be crossed with farm machinery are common. The pattern of soils is variable; some areas contain only the Konawa soil, some only the Teller soil, and some contain both. Individual areas of this group are irregular in shape and range from 10 to 200 acres in size.

This group is 45 percent Konawa soil, 35 percent Teller soil, and 20 percent included soils.

The Konawa soil typically has a surface layer of brown loamy fine sand about 5 inches thick. The subsurface layer is light brown loamy fine sand about 2 inches thick. The subsoil extends to a depth of about 60 inches. The upper 7 inches is yellowish red sandy clay loam, the next 25 inches is reddish yellow sandy clay loam, and the lower 21 inches is yellowish red fine sandy loam.

The Konawa soil is low in natural fertility and organic matter content. Reaction of the surface layer ranges from strongly acid to slightly acid. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Teller soil typically has a surface layer of reddish brown fine sandy loam about 7 inches thick. The subsoil extends to a depth of about 80 inches. The upper 6 inches is reddish brown loam, the next 8 inches is reddish brown clay loam, the next 9 inches is red clay loam, the next 14 inches is red loam, and the lower 36 inches is red fine sandy loam.

The Teller soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from slightly acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Dougherty, Minco, Mulhall, Navina, Norge, and Slaughterville soils. Dougherty soils are on convex side slopes in lower positions. Minco soils are generally in higher positions. Mulhall, Navina, and Norge soils are in positions similar to those of the Konawa and Teller soils. Slaughterville soils are in slightly lower positions. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of these soils are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and alfalfa.

These soils have low potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to these soils. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

These soils have high potential for openland and rangeland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations. Septic tank absorption fields function well in these soils if properly designed and installed. Onsite investigation is essential.

These soils are in capability subclass IVe. The Konawa soil is in Deep Sand Savannah range site, and the Teller soil is in Loamy Prairie range site.

60—Mulhall loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on broad, linear side slopes on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown loam about 13 inches thick. The subsoil extends to a depth of about 70 inches. The upper 4 inches is reddish brown loam, and the lower 53 inches is yellowish red and red clay loam. The underlying material is red, weakly laminated, calcareous silty shale.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is good, but the soil should not be worked when wet. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Agra, Coyle, Chickasha, Grainola, Huska, Renfrow, and Zaneis soils. Agra soils are in lower positions on convex side slopes. Coyle soils are on convex ridge crests. Chickasha and Zaneis soils generally are on lower side slopes. Grainola soils are on convex upper side slopes. Huska soils are on slightly concave lower side slopes. Renfrow soils are on convex lower side slopes. Also included are areas on upper side slopes of a soil that is similar to Mulhall soils but that has shale bedrock within 40 inches of the surface. Included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Mulhall soil are used for range or tame pasture. Where the soil is cultivated, the principal crop is wheat.

This soil has medium potential for crops. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is medium to high. Seepage, moderate permeability, and slope are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields will function if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

61—Mulhall loam, 3 to 5 percent slopes, eroded. This gently sloping, loamy soil is on broad, linear side slopes on eroded uplands. It is deep and well drained. This soil has been cultivated in the past, and water erosion has removed much of the surface layer leaving the subsoil exposed over more than half of the area. Rills and shallow gullies that can be crossed with farm machinery are common. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil extends to a depth of about 74 inches. The upper 4 inches is dark brown loam, the next 48 inches is brown and reddish brown clay loam, and the lower 16 inches is yellowish red clay loam. The underlying material is yellowish red silty shale.

Natural fertility is medium, and organic matter content is high. Reaction of the surface layer is neutral or mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Chickasha, Grainola, Huska, Renfrow, and Zaneis soils. Coyle soils are on convex ridge crests. Chickasha and Zaneis soils are on convex lower side slopes. Grainola soils are on convex upper side slopes. Huska soils are on slightly concave lower side slopes. Renfrow soils are on slightly convex lower side slopes. Also included are areas on upper side slopes of a soil that is similar to Mulhall soils but that has shale bedrock within 40 inches of the surface. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Mulhall soil are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

This soil has low potential for crops. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is medium to high. Seepage and moderate permeability are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields will function if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

62—Mulhall loam, 3 to 5 percent slopes, gullied. This gently sloping, loamy soil is on broad, linear side slopes on gullied uplands. It is deep and well drained. This soil has been cultivated in the past and severe water erosion has formed gullies, most of which cannot be crossed with farm machinery. Gullies make up 8 percent of each mapped area. The soil is between the gullies. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loam about 14 inches thick. The subsoil extends to a depth of about 80 inches. The upper 4 inches is reddish brown loam, the next 25 inches is reddish brown clay loam that grades to reddish yellow sandy clay loam, and the lower 37 inches is red sandy clay loam that grades to red clay loam.

Natural fertility is medium, and organic matter content is high. Reaction of the surface layer is neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Chickasha, Grainola, Huska, Renfrow, and Zaneis soils. Coyle soils are on convex ridge crests. Chickasha and Zaneis soils are on convex lower side slopes. Grainola soils are on convex upper side slopes. Huska soils are on slightly concave lower side slopes. Renfrow soils are on slightly convex lower side slopes. Also included are areas on upper side slopes of soils that are similar to Mulhall soils but that have shale within 40 inches of the surface. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of these soils are used for range. A few areas are used for tame pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion and deep gullies are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. Deep gullies make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is medium or high. Seepage, moderate permeability, and slope are the main limitations, but they can usually be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass VIe; Eroded Prairie range site.

63—Goodnight loamy fine sand, 5 to 20 percent slopes. This hummocky to rolling, sandy soil is on convex flood plains along the Cimarron River. This soil is deep and excessively drained. Individual areas are long and narrow in shape and range from 15 to 350 acres in size.

Typically, the surface layer is brown loamy fine sand about 5 inches thick. The subsoil is light brown and reddish yellow fine sand to a depth of about 40 inches. The underlying material is reddish yellow fine sand to a depth of 80 inches or more.

Natural fertility and organic matter content are low. Reaction of the surface layer ranges from slightly acid to moderately alkaline. Available water capacity is low. Permeability is rapid, and surface runoff is very slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Canadian, Derby, Gaddy, Harjo Variant, Hawley, and Yahola soils. Canadian, Gaddy, Hawley, and Yahola soils are in lower positions on the flood plains. Derby soils are in slightly higher positions on dunes. Harjo Variant soils are in depressional areas in lower positions. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil is used for range.

This soil is not suited to cultivated crops or to pasture and hay. The very severe hazard of erosion and the steep slopes are limitations that are very difficult to overcome.

This soil has medium potential for range. Little bluestem, indiangrass, and sand bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The lack of available water in the subsoil restricts the growth and development of trees.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Slope, seepage, and poor filtering capacity are the main limitations, but they can usually be overcome by proper design or soil modification. Septic tank absorption fields will function properly only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass VIIe; Deep Sand Savannah range site.

64—Navina loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, slightly convex ridgetops and side slopes on uplands. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is dark brown loam about 19 inches thick. The subsoil extends to a depth of about 80 inches. The upper 17 inches is brown clay loam, the next 12 inches is light yellowish brown sandy clay loam, and the lower 32 inches is reddish yellow fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Konawa, Norge, and Teller soils. Konawa soils are in lower positions. Norge soils are in higher positions. Teller soils are in positions similar to that of the Navina soil and are intermingled with it. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Navina soil are used for crops. The principal crops are wheat, alfalfa, and peanuts.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability, slope, and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

65—Grainola clay loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on convex side slopes on uplands. This soil is moderately deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark reddish gray clay loam about 6 inches thick. The subsoil extends to a depth of about 35 inches. The upper 13 inches is reddish brown clay, and the lower 16 inches is red silty clay. The underlying material to a depth of 48 inches or more is red shale.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from neutral to moderately alkaline. Available water capacity is medium. Permeability is slow, and surface runoff is medium. Tilth is good, but the soil should not be worked when wet. The root zone is moderately deep, but roots have difficulty penetrating the dense clay subsoil.

Included with this soil in mapping are small areas of Coyle, Huska, Lucien, Masham, Mulhall, and Renfrow soils. Coyle and Lucien soils formed in material weathered from sandstone on convex ridgetops above the Grainola soil. Huska soils are on slightly concave areas. Masham soils are on steeper side slopes below the Grainola soil. Mulhall soils are on smooth side slopes below the Grainola soil. Renfrow soils are in positions similar to that of the Grainola soil. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Grainola soil are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

This soil has low potential for crops. Small grains and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has low potential for windbreaks and environmental plantings. The dense clay subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Shrinking and swelling, slow permeability, and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVe; Shallow Prairie range site.

66—Masham silty clay loam, 5 to 20 percent slopes. This sloping to moderately steep, loamy soil is on convex side slopes on uplands in the central and western parts of Payne County. This soil is shallow and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is reddish brown silty clay loam about 5 inches thick. The subsoil is reddish brown silty clay to a depth of about 16 inches. The underlying material is reddish brown weathered silty shale that becomes harder with depth.

Natural fertility and organic matter content are medium. Reaction of the surface layer is moderately alkaline. Available water capacity is low. Permeability is very slow, and surface runoff is rapid. The root zone is shallow, and roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Ashport, Grainola, and Lucien soils. Ashport soils are along narrow drainageways on the lowest positions. Grainola soils are generally on convex, more gently sloping, lower side slopes. Lucien soils are on convex ridge crests in higher positions. Also included are areas of raw shale and of a soil that is similar to Masham soils but that is more than 20 inches thick and is on toe slopes below raw shale escarpments. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for rangeland. A few areas are used for tame pasture.

This soil is not suited to cultivated crops or to tame pasture and hay. The very severe hazard of erosion, steep slopes, and shallow depth to bedrock are limitations that are very difficult to overcome.

This soil has low potential for range. Little bluestem, sideoats grama, blue grama, and buffalograss are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has low potential for windbreaks and environmental plantings. The dense subsoil, shallow depth to rock, and lack of available water in the subsoil restrict the growth and development of trees.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low. Shrinking and swelling, very slow permeability, low strength, slope, and depth to rock are the main limitations, but they can ususally be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, and sewage lagoons are suitable only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass VIe; Red Clay Prairie range site.

67—Slaughterville fine sandy loam, 6 to 20 percent slopes. This sloping to moderately steep, loamy soil is on narrow, convex side slopes on uplands on the north side of the Cimarron River. This soil is deep and well drained. Individual areas are long and narrow in shape and range from 10 to 200 acres in size.

Typically, the surface layer is reddish brown fine sandy loam about 16 inches thick. The subsoil extends to a depth of about 80 inches. The upper 19 inches is yellowish red fine sandy loam, and the lower 45 inches is reddish yellow fine sandy loam.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is moderately rapid, and surface runoff is medium. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Derby soils, of soils that are similar to Slaughterville soils but that are underlain by sandstone bedrock at a depth of 30 to 60 inches, and of Rock outcrop. Derby soils are on higher convex dunes. The soils that are similar to Slaughterville soils and the Rock outcrops are on lower side slopes. The included areas make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range.

This soil is not suited to cultivated crops. The very severe hazard of erosion and steep slopes are limitations that are very difficult to overcome.

Potential for tame pasture and hay is medium. The very severe hazard of erosion and steep slopes make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and sideoats grama are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is medium. Slope and seepage are the main limitations, but they can usually be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass VIe; Sandy Prairie range site.

68—Yahola fine sandy loam, occasionally flooded. This nearly level, loamy soil is on low, narrow to broad, linear flood plains along the Cimmarron River. This soil is deep and well drained. This soil is subject to damaging floods at least once in 10 years. These floods occur from March through October and usually last not longer than 24 hours, although some last as long as 72 hours. Individual areas are long and narrow in shape and range from 20 to 300 acres in size.

Typically, the surface layer is reddish brown fine sandy loam about 8 inches thick. The underlying material extends to a depth of 64 inches or more. The upper 26 inches is reddish yellow, stratified fine sandy loam, the next 12 inches is light red, stratified fine sandy loam, and the lower 18 inches is reddish yellow, stratified loamy fine sand.

Natural fertility is medium, and organic matter content is low. Reaction of the surface layer is mildly alkaline or moderately alkaline. Available water capacity is high. Permeability is moderately rapid, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping ae small areas of Gaddy, Goodnight, Harjo Variant, and Hawley soils and of a soil that is similar to Yahola soils but that has a clay loam surface layer. Gaddy soils are in lower positions. Goodnight soils are on convex dunes. Harjo Variant soils are in depressions. Hawley soils are in higher positions. The soil that is similar to Yahola soils is in slightly concave areas. The included soils make up about 15 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Yahola soil are used for crops or tame pasture. The principal crops are wheat, alfalfa, and grain sorghum.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity.

Potential for tame pasture and hay is high. Bermudagrass and other adapted adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth, but flooding can make establishment difficult.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The hazard of occasional flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass IIw; Loamy Bottomland range site.

69—Zaneis loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, convex upland ridgetops. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is reddish brown loam about 11 inches thick. The subsoil extends to a depth of about 47 inches. The upper 3 inches is reddish brown loam, the next 15 inches is reddish brown clay loam, and the lower 18 inches is yellowish red clay loam. The underlying material is yellowish red sandstone that is hard when dry and rippable when moist.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions.

Included with this soil in mapping are small areas of Coyle, Chickasha, Doolin, Huska, and Renfrow soils. Coyle soils are in higher positions on convex ridge crests. Chickasha soils are in positions similar to that of the Zaneis soil and are intermingled with it. Doolin and Huska soils are in slightly concave areas. Renfrow soils are on convex lower side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Zaneis soil are used for crops or tame pasture. The principal crops are wheat and grain sorghum.

This soil has medium to high potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, moderately slow permeability, and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIe; Loamy Prairie range site.

70—Zaneis loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on broad, convex side slopes on uplands. It is deep and well drained. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is dark reddish gray and reddish brown loam about 11 inches thick. The subsoil extends to a depth of about 42 inches. The upper 5 inches is reddish brown loam, and the lower 26 inches is reddish brown clay loam. The underlying material is red sandstone that is rippable when moist and hard when dry.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Chickasha, Huska, Mulhall, and Renfrow soils. Coyle soils are on convex upper side slopes. Chickasha soils are in positions similar to that of the Zaneis soil and are intermingled with it. Huska soils are on lower, slightly concave side slopes. Mulhall soils are on linear lower side slopes. Renfrow soils are on convex lower side slopes. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Zaneis soil are used for tame pasture or crops. The principal crops are wheat and grain sorghum.

This soil has low to medium potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, moderately slow permeability, steep slopes, and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

71—Zaneis loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping, loamy soil is on broad, slightly convex ridgetops and side slopes on uplands. This soil is deep and well drained. This soil has been cultivated in the past, and water erosion has removed much of the surface layer leaving the subsoil exposed over much of the area. Rills and shallow gullies that can be crossed with farm machinery are common. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil extends to a depth of about 50 inches. The upper 5 inches is reddish brown clay loam, the next 12 inches is yellowish red clay loam, the next 14 inches is red clay loam, and the lower 12 inches is red sandy clay loam. The underlying material is red sandstone that is hard when dry and rippable when moist.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from medium acid to slightly acid. Available water capacity is high. Permeability is moderately slow, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Coyle, Chickasha, Huska, Mulhall, and Renfrow soils. Coyle soils are on convex upper side slopes. Chickasha soils are in positions similar to that of the Zaneis soil and are intermingled with it. Huska soils are on slightly concave areas on lower side slopes. Mulhall soils are on linear lower side slopes. Renfrow soils are on slightly convex lower side slopes. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Zaneis soil are used for tame pasture or crops. The principal crops are wheat and grain sorghum.

This soil has low potential for crops. Small grains, row crops, vegetables, and fruits are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing,

timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, moderately slow permeability, slope, and depth to rock are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Loamy Prairie range site.

72—Zaneis-Huska complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping soils on broad, slightly convex ridgetops and side slopes on upland watershed divides in the central and western parts of Payne County. The Zaneis soil is deep and well drained. The Huska soil is deep and moderately well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 200 acres in size.

This complex is 50 percent Zaneis soil, 30 percent Huska soil, and 20 percent included soils. The Zaneis soil is on convex side slopes, and the Huska soil is in slightly concave, oval areas.

The Zaneis soil typically has a surface layer of reddish brown fine sandy loam about 7 inches thick. The subsoil extends to a depth of about 54 inches. The upper 4 inches is reddish brown loam, the next 21 inches is reddish brown clay loam, the next 13 inches is yellowish red sandy clay loam, and the lower 9 inches is red sandy clay loam. The underlying material is red sandstone that is hard when dry and rippable when moist.

The Zaneis soil is high in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep and can be easily penetrated by plant roots.

The Huska soil typically has a surface layer of brown fine sandy loam about 4 inches thick. The subsoil extends to a depth of about 51 inches. The upper 16 inches is reddish brown clay, the next 12 inches is reddish yellow clay loam, and the lower 19 inches is red clay loam. The underlying material is red sandstone that is hard when dry and rippable when moist.

The Huska soil is low to medium in natural fertility and medium in organic matter content. Reaction of the surface layer ranges from medium acid to neutral. The subsoil is high in sodium. Available water capacity is low. Permeability is very slow, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with these soils in mapping are small areas of Coyle, Doolin, Grainola, Lucien, Mulhall, and Renfrow soils. Coyle and Grainola soils are on convex ridgetops and upper side slopes. Doolin soils are on slightly concave ridgetops. Lucien soils are on ridgetops and upper side slopes. Mulhall soils are on linear lower side slopes. Renfrow soils are on convex side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

These soils have low potential for crops. Small grains and row crops are suited. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, application of gypsum, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soils in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, switchgrass, and sideoats grama are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium potential for windbreaks and environmental plantings. The dense clay subsoil of the Huska soil restricts root growth of many of the plants that can be established on this soil.

These soils have medium potential for openland and rangeland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, moderately slow permeability, slope, and depth to rock are the main limitations of the Zaneis soil. Shrinking and swelling, excess sodium, very slow permeability, and depth to rock are the main limitations of the Huska soil. Septic tank absorption fields function poorly in these soils, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass IVs. The Zaneis soil is in Loamy Prairie range site, and the Huska soil is in Shallow Claypan range site.

73—Dale silt loam, rarely flooded. This nearly level, loamy soil is on high, broad flood plains along the Cimarron River and on high, narrow flood plains along major tributaries. This soil is deep and well drained. It is subject to damaging floods once in more than 20 years. These floods occur from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark reddish gray silt loam about 26 inches thick. The subsoil is reddish brown loam to a depth of about 48 inches. The underlying material to a depth of 78 inches or more is reddish brown loam that grades to yellowish red fine sandy loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, but the soil should not be worked when wet. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Asher, Canadian, Hawley, and McLain soils. Asher soils are in slightly concave areas away from the stream channel. Canadian and McLain soils are in positions similar to that of the Dale soil. Hawley soils are in slightly lower positions nearer the stream channel. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Dale soil are used for crops. The principal crops are wheat, alfalfa, and grain sorghum.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The hazard of rare flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability class I; Loamy Bottomland range site.

74—Coyle-Lucien complex, 2 to 5 percent slopes. This complex consists of very gently sloping to gently sloping, loamy soils on uplands. The Coyle soil is moderately deep and well drained. The Lucien soil is shallow and well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 150 acres in size.

This complex is 50 percent Coyle soil, 30 percent Lucien soil, and 20 percent included soils. The Coyle soil is on side slopes, and the Lucien soil is on convex ridgetops.

The Coyle soil typically has a surface layer of reddish brown fine sandy loam about 10 inches thick. The subsoil is reddish brown sandy clay loam to a depth of about 30 inches. The underlying material to a depth of 35 inches or more is yellowish red sandstone that is rippable when moist.

The Coyle soil is high in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is moderately deep and can be easily penetrated by plant roots.

The Lucien soil typically has a surface layer of reddish brown fine sandy loam about 7 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 17 inches. The underlying material is yellowish red sandstone that is rippable when moist.

The Lucien soil is high in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is medium. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions.

Included with these soils in mapping are small areas of Darnell, Grainola, Huska, Mulhall, Renfrow, Stephenville, and Zaneis soils. Darnell, Stephenville, and Zaneis soils are in positions similar to those of the Coyle and Lucien soils. Grainola and Renfrow soils are on convex side slopes below the Coyle and Lucien soils. Huska soils are in slightly concave areas. Mulhall soils are on smooth side slopes below the Coyle and Lucien soils. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

These soils have low potential for crops. Small grains are suited to these soils. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using this complex for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soils in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low to medium potential for windbreaks and environmental plantings. The moderate and shallow depth to rock in both soils restricts root development. The lack of available water in the subsoil of the Lucien soil restricts the growth and development of trees.

These soils have high to low potential for openland and rangeland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Slope and depth to rock are the main limitations of the Coyle soil. Seepage and depth to rock are the main limitations of the Lucien soil. Septic tank absorption fields will function in these soils only if the soil is extensively modified. Onsite investigation is essential.

This complex is in capability subclass IVe. The Coyle soil is in Loamy Prairie range site, and the Lucien soil is in Shallow Prairie range site.

75—Konawa loamy fine sand, 2 to 6 percent slopes, gullied. This very gently sloping to sloping, sandy soil is on broad, convex side slopes on uplands. It is deep and well drained. It has been cultivated in the past, and severe water erosion has formed gullies, most of which cannot be crossed with farm machinery. The soil is between the gullies. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is brown loamy fine sand about 8 inches thick. The subsurface layer is light brown loamy fine sand about 4 inches thick. The subsoil extends to a depth of about 80 inches. The upper 22 inches is yellowish red sandy clay loam, the next 16 inches is reddish yellow fine sandy loam, and the lower 30 inches is reddish yellow and red loamy fine sand.

Natural fertility is low, and organic matter content is low to medium. Reaction of the surface layer ranges from slightly acid to neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Dougherty, Eufaula, and Teller soils. Dougherty soils are in slightly lower positions on convex side slopes. Eufaula soils are on low side slopes near drainageways. Teller soils are on ridge crests in higher positions. The included soils make up about 30 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range. A few areas are used for tame pasture.

This soil is not suited to cultivated crops. The very severe hazard of erosion and the deep gullies are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. Deep gullies make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, shaping gullies, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem and big bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass VIe; Eroded Sandy Savannah range site.

76—Coyle and Zaneis soils, 2 to 5 percent slopes, severely eroded. This group consists of very gently sloping to gently sloping, loamy soils on broad, convex side slopes on severely eroded uplands. The Coyle soil is moderately deep and well drained. The Zaneis soil is deep and well drained. These soils have been cultivated in the past, and very severe water erosion has removed much of the original surface layer and formed many shallow gullies, some of which can be crossed with farm machinery and some of which cannot. The pattern of soils is not uniform; some areas are mostly Coyle loam, but most areas contain both kinds of soil. Individual areas of this group are irregular in shape and range from 10 to 100 acres in size.

This group is 45 percent Coyle soil, 30 percent Zaneis soil, and 25 percent included soils.

The Coyle soil typically has a surface layer of reddish brown loam about 7 inches thick. The subsoil extends to a depth of about 32 inches. The upper 4 inches is reddish brown loam, the next 10 inches is reddish brown clay loam, and the lower 11 inches is red clay loam. The underlying material is red sandstone that is rippable when moist.

The Coyle soil is medium in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. The root zone is moderately deep and can be easily penetrated by plant roots.

The Zaneis soil typically has a surface layer of reddish brown loam about 8 inches thick. The subsoil extends to a depth of about 48 inches. The upper 15 inches is reddish brown clay loam, and the lower 25 inches is yellowish red clay loam. The underlying material is yellowish red sandstone that is rippable when moist.

The Zaneis soil is medium in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is high. Permeability is moderately slow, and surface runoff is medium. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Chickasha, Grainola, Huska, Lucien, Mulhall, Renfrow, and Stephenville soils. Chickasha, Lucien, and Stephenville soils are in positions similar to those of the Coyle and Zaneis soils. Grainola and Renfrow soils are on convex side slopes below the Coyle and Zaneis soils. Huska soils are in slightly concave areas intermingled with the Coyle and Zaneis soils. Mulhall soils are on smooth side slopes below the Coyle and Zaneis soils. The included soils make up about 25 percent of of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of these soils are used for range. A few areas are used for tame pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion is very difficult to overcome.

Potential for tame pasture and hay is low. The very severe hazard of erosion makes establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have low potential for range. Little bluestem, big bluestem, tall dropseed, and sideoats grama are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium potential for windbreaks and environmental plantings. The moderate depth to rock of the Coyle soil restricts root development.

These soils have medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Depth to rock is the main limitation of the Coyle soil. Shrinking and swelling, moderately slow permeability, slope, and depth to rock are the main limitations of the Zaneis soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function poorly in the Zaneis soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Coyle soil only if the soil is modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

These soils are in capability subclass VIe and Eroded Prairie range site.

77—Chickasha-Seminole complex, 2 to 5 percent slopes, gullied. This complex consists of very gently sloping to gently sloping, loamy soils on uplands mainly in the southeastern part of Payne County. The Chickasha soil is deep and well drained. The Seminole soil is deep and moderately well drained. These soils have been cultivated in the past, and very severe water erosion has removed much of the original surface layer and formed many gullies, most of which cannot be crossed with farm machinery. The gullies make up about 8 percent of each mapped area. The soils are between the gullies. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 100 acres in size.

This complex is 50 percent Chickasha soil, 30 percent Seminole soil, and 20 percent included soils. The Chickasha soil is on convex upper side slopes, and the Seminole soil is on slightly concave lower side slopes.

The Chickasha soil typically has a surface layer of dark brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper 18 inches is brown sandy clay loam, the next 12 inches is mottled brownish yellow sandy clay loam, the next 17 inches is mottled very pale brown sandy clay loam, and the lower 5 inches is coarsely mottled sandy clay loam. The underlying material is brown sandstone.

The Chickasha soil is medium in natural fertility and organic matter content. Reaction of the surface layer ranges from medium acid to neutral. Available water capacity is high. Permeability is moderate, and surface runoff is medium. The root zone is deep and can be easily penetrated by plant roots.

The Seminole soil typically has a surface layer of dark brown loam about 8 inches thick. The subsoil extends to a depth of about 63 inches. The upper 20 inches is reddish yellow clay loam, the next 28 inches is brownish yellow mottled silty clay loam, and the lower 7 inches is coarsely mottled silty clay. The underlying material is light brownish gray sandy shale.

The Seminole soil is medium in natural fertility and high in organic matter content. Reaction of the surface layer ranges from medium acid to neutral. The subsoil is high in sodium. Available water capacity is low. A perched water table is at a depth of 1 to 2 feet in spring. Permeability is slow, and surface runoff is medium. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with these soils in mapping are small areas of Agra, Coyle, Doolin, Huska, and Zaneis soils. Agra and Zaneis soils are on convex side slopes. Coyle soils are on convex ridgetops. Doolin and Huska soils are on broad, slightly concave ridgetops. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for tame pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion and deep gullies are very difficult to overcome.

Potential for tame pasture and hay is low. Deep gullies make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to the Chickasha soil. Bermudagrass is suited to the Seminole soil. Using this complex for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, shaping gullies, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low potential for windbreaks and environmental plantings. The dense subsoil of the Seminole soil restricts root growth of many of the plants that can be established on this soil.

This complex has high potential for openland wildlife habitat, medium potential for rangeland wildlife habitat, and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability, slope, seepage, and depth to rock are the main limitations of the Chickasha soil. Shrinking and swelling, slow permeability, wetness, excess sodium, and slope are the main limitations of the Seminole soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function in the Chickasha soil if properly designed and installed. Septic tank absorption fields will function in the Seminole soil only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIe. The Chickasha soil is in Eroded Prairie range site, and the Seminole soil is in Eroded Clay range site.

78—Seminole loam, 0 to 2 percent slopes. This nearly level to very gently sloping, loamy soil is on broad, slightly concave ridgetops on uplands in the southeastern part of Payne County. This soil is deep and moderately well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loam about 12 inches thick. The subsoil is high in sodium and extends to a depth of about 60 inches. The upper 3 inches is dark brown loam, the next 9 inches is brown clay, the next 8 inches is strong brown clay loam, and the lower 28 inches is coarsely mottled clay loam.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from slightly acid to neutral. Available water capacity is medium. A perched water table is at a depth of 1 to 2 feet in spring. Permeability is slow, and surface runoff is slow. Tilth is good, but the soil should not be worked when wet. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Agra, Huska, and Chickasha soils. Agra soils are on convex side slopes. Huska soils are on lower, slightly concave side slopes. Chickasha soils are on higher, convex ridgetops and upper side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Seminole soil are used for crops or tame pasture. The principal crops are wheat and grain sorghum.

This soil has low to medium potential for crops. Small grains, row crops, and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, application of gypsum, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland wildlife habitat, medium potential for rangeland wildlife habitat, and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, excess sodium, slow permeability, and wetness are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Claypan Prairie range site.

79—Seminole loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping, loamy soil is on broad, slightly concave ridgetops and side slopes on eroded uplands in the southeastern part of Payne County. This soil is deep and moderately well drained. This soil has been cultivated in the past, and water erosion has removed much of the surface layer leaving the subsoil exposed over more than half of the area. Rills and shallow gullies that can be crossed with farm machinery are common. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loam about 4 inches thick. The subsoil extends to a depth of about 72 inches. The upper 10 inches is strong brown clay, the next 18 inches is light brown clay, the next 13 inches is coarsely mottled clay loam, and the lower 27 inches is coarsely mottled clay.

Natural fertility and organic matter content are medium. Reaction of the surface layer is slightly acid or neutral. The subsoil is high in sodium. Available water capacity is medium or low. A perched water table is at a depth of 1 to 2 feet in spring. Permeability is slow, and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Agra, Huska, and Chickasha soils. Agra soils are on convex side slopes. Huska soils are on slightly concave lower side slopes. Chickasha soils are on convex ridgetops and upper side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Seminole soil are used for tame pasture. Where the soil is cultivated, the principal crop is wheat.

This soil has low potential for crops. Small grains and row crops are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, application of gypsum, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass and other adapted adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to low potential for windbreaks and environmental plantings. The dense subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has high potential for openland wildlife habitat, medium potential for rangeland wildlife habitat, and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, excess sodium, slow permeability, and wetness are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVe; Claypan Prairie range site.

80—Renfrow-Urban land complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping Renfrow soil and Urban land on broad, slightly convex ridgetops and side slopes on uplands. The Renfrow soil is deep and well drained. Areas of the Renfrow soil and Urban land are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 100 to 1,000 acres in size.

This complex is 40 percent Renfrow soil, 30 percent Urban land, and 30 percent included soils. The Renfrow soil is in undisturbed areas such as lawns and vacant lots.

The Renfrow soil typically has a surface layer of reddish gray loam about 9 inches thick. The subsoil extends to a depth of 69 inches. The upper 3 inches is reddish brown clay loam, the next 9 inches is reddish brown silty clay, and the lower 48 inches is yellowish red and red silty clay. The underlying material is red clayey shale.

This soil is high in natural fertility and organic matter content. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is very slow, and surface runoff is medium. The shrink-swell potential is high. The root zone is deep, but the dense subsoil somewhat restricts root growth.

Urban land consists of streets, single and multi-unit dwellings, driveways, business buildings, schools, churches, airports, and parking lots.

Included in mapping are small areas of Coyle, Grainola, Huska, Kirkland, Lucien, Mulhall, Norge, and Zaneis soils and areas of soils that have been altered by cutting, grading, and filling. Coyle, Lucien, and Zaneis soils are on ridge crests and convex lower side slopes. Grainola and Mulhall soils are in positions similar to that of the Renfrow soil and are intermingled with it. Huska and Kirkland soils are in slightly concave, nearly level to very gently sloping areas. Norge soils are below the Renfrow soil. These soils make up about 30 percent of any mapped area, but individual areas are smaller than 5 acres.

Areas of this complex are used mostly for residential, business, and industrial uses.

Potential for most urban and recreational uses ranges from low to high. The very slow permeability and shrinking and swelling are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly, and sewage lagoons are preferable if central sewage service is not available. Shrinking and swelling can be overcome by proper design and installation. Slope moderately limits use for playgrounds.

This complex is not assigned to a capability subclass or range site.

81—Huska silt loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, slightly concave ridgetops on uplands on high watershed divides. This soil is deep and moderately well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is brown silt loam about 9 inches thick. The subsoil extends to a depth of about 50 inches. The upper 9 inches is reddish brown silty clay, the next 7 inches is reddish brown silty clay loam, and the lower 25 inches is yellowish red and red clay. The underlying material is light gray sandstone.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from medium acid to neutral. The subsoil is high in sodium. Available water capacity is low. Permeability is very slow and surface runoff is medium. Tilth is poor, and surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Agra, Coyle, Doolin, Grainola, Seminole, Renfrow, and Zaneis soils. Agra soils are on convex ridgetops and side slopes. Coyle, Grainola, Renfrow, and Zaneis soils are on convex side slopes below the Huska soil. Doolin and

Seminole soils are in positions similar to that of the Huska soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Huska soil are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

This soil has low potential for crops. Small grains are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, application of gypsum, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and sideoats grama are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has low potential for windbreaks and environmental plantings. The dense clay subsoil restricts root growth of many of the plants that can be established on this soil, and the lack of available water in the subsoil restricts the growth and development of trees.

This soil has low potential for openland, rangeland, and wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low to medium. Shrinking and swelling, very slow permeability, depth to rock, and excess sodium are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IVs; Shallow Claypan range site.

82—Derby-Slaughterville complex, 1 to 5 percent slopes. This complex consists of gently undulating soils on uplands on the north side of the Cimarron River. The Derby soil is deep and somewhat excessively drained. The Slaughterville soil is deep and well drained. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 20 to 200 acres in size.

This complex is 50 percent Derby soil, 40 percent Slaughterville soil, and 10 percent included soils. The Derby soil is on broad, convex hummocks, and the Slaughterville soil is in lower, slightly concave areas between dunes.

The Derby soil typically has a surface layer of light brown loamy fine sand about 18 inches thick. The subsurface layer is pink fine sand to a depth of about 54 inches. The subsoil extends to a depth of about 72 inches. It is reddish yellow fine sand with thin bands of yellowish red loamy fine sand.

The Derby soil is low in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is low. Permeability is rapid, and surface runoff is very slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

The Slaughterville soil typically has a surface layer of brown fine sandy loam about 18 inches thick. The subsoil extends to a depth of about 54 inches. The upper 8 inches is brown fine sandy loam, and the lower 28 inches is light brown fine sandy loam. The underlying material to a depth of 72 inches or more is pink loamy fine sand.

The Slaughterville soil is medium in natural fertility and medium in organic matter content. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is medium. Permeability is moderatley rapid, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Dougherty, Konawa, Minco, and Teller soils. Dougherty and Konawa soils are in slightly higher positions on convex side slopes. Minco and Teller soils are in broad, convex areas in slightly higher positions. The included soils make up about 10 percent of the complex, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for tame pasture or range. Where the soil is cultivated, the principal crop is wheat.

These soils have low potential for crops. Small grains, vegetables, fruits, and nuts are suited to these soils. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to these soils. Caucasian and plains bluestem are suited to the Slaughterville soil. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have medium potential for range. Little bluestem, indiangrass, big bluestem, and sand bluestem are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium to high potential for windbreaks and environmental plantings. The lack of available water in the subsoil of the Derby soil restricts the growth and development of trees.

This complex has medium to high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Seepage and poor filtering capacity are the main limitations of the Derby soil. Seepage is the main limitation of the Slaughterville soil. Septic tank absorption fields function well in the Slaughterville soil if properly designed and installed. Septic tank absorption fields will function in the Derby soil only if the soil is extensively modified. Onsite investigation is essential.

This complex is in capability subclass IVe. The Derby soil is in Deep Sand Savannah range site, and the Slaughterville soil is in Sandy Prairie range site.

83—Derby fine sandy loam, 5 to 15 percent slopes. This hummocky to rolling, loamy soil is on broad, convex uplands along the north side of the Cimarron River. This soil is deep and somewhat excessively drained. Individual areas are irregular in shape and range from 10 to 150 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The upper 18 inches of the subsurface layer is brown loamy fine sand, and the lower 30 inches is yellow fine sand. The subsoil extends to a depth of more than 80 inches. The upper 18 inches is yellow fine sand with thin bands of yellowish red loamy fine sand, and the lower 48 inches is very pale brown fine sand with thin bands of yellowish red loamy fine sand.

Natural fertility and organic matter content are low. Reaction of the surface layer ranges from medium acid to mildly alkaline. Available water capacity is low. Permeability is rapid, and surface runoff is very slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Eufaula, Goodnight, and Slaughterville soils. Eufaula soils are on convex side slopes in slightly higher positions than the Derby soil. Goodnight soils are on convex dunes in lower positions than the Derby soil. Slaughterville soils are in concave areas. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range. A few areas are used for tame pasture.

This soil is not suited to cultivated crops. The very severe hazard of erosion and steep slopes are limitations that are very difficult to overcome.

Potential for tame pasture and hay is low. The very severe hazard of erosion and steep slopes make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, and sand bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The lack of available water in the subsoil restricts the growth and development of trees.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is medium or low. Slope, seepage, and poor filtering capacity are the main limitations, but they can usually be overcome by proper design or soil modification. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass VIe; Deep Sand Savannah range site.

84—Hawley fine sandy loam, rarely flooded, undulating. This loamy soil is on high, narrow flood plains along the Cimarron River. This soil is deep and well drained. Slope ranges from 0 to 3 percent. This soil is subject to damaging floods once in more than 20 years. These floods occur from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 20 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is yellowish red fine sandy loam to a depth of about 32 inches. The underlying material to a depth of 60 inches or more is reddish yellow fine sandy loam stratified with loam to fine sand.

Natural fertility and organic matter content are medium. Reaction of the surface layer is neutral or mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Asher, Canadian, Dale, Goodnight, and Yahola soils. Asher soils are in slightly concave areas away from the stream channel. Canadian and Dale soils are in slightly higher positions. Goodnight soils are on convex dunes. Yahola soils are in slightly lower positions nearer the stream channel. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Hawley soil are used for crops. The principal crops are wheat, grain sorghum, and alfalfa.

This soil has high potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. The rare flooding is a major limitation and is difficult to overcome. Septic tank absorption fields function if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Loamy Bottomland range site.

86—Tribbey fine sandy loam, frequently flooded. This nearly level, loamy soil is on low, narrow, slightly concave flood plains of minor tributaries in the southern half of Payne County. This soil is deep and somewhat poorly drained. This soil is subject to damaging floods at least once in 2 years. These floods occur from March through October and last as long as 72 hours. Individual areas are long and narrow in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The underlying material extends to a depth of 60 inches or more. The upper 34 inches is reddish brown stratified fine sandy loam, and the lower 20 inches is brown fine sandy loam.

Natural fertility is low to medium, and organic matter content is low. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. An apparent water table is at a depth of $1^1/_2$ to $3^1/_2$ feet in winter and spring. Permeability is moderate and moderately rapid, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Pulaski soils. Pulaski soils are in higher positions away from the stream channel. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range. A few areas are used for tame pasture.

This soil is not suited to cultivated crops. The flooding and high water table are very difficult to overcome.

Potential for tame pasture and hay is medium. The frequent flooding and high water table can make establishment of improved grasses difficult. Bermudagrass, tall fescue, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Eastern gamagrass, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. Flooding can make establishment of plants difficult.

This soil has medium potential for openland and rangeland wildlife habitat and high potential for wetland wildlife habitat. Grasses and legumes and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low. The hazard of flooding and wetness are major limitations and are difficult to overcome. Onsite investigation is essential.

Capability subclass Vw; Wetland range site.

87—Steedman-Gowen complex, 0 to 8 percent slopes. This complex consists of nearly level to sloping soils in the eastern part of Payne County. The Steedman soil is moderately deep and is well drained and moderately well drained. The Gowen soil is deep and well drained. The Gowen soil is subject to damaging floods at least once in 2 years. These floods occur from March through October and last less than 24 hours. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are long and narrow in shape and range from 5 to 100 acres in size.

This complex is 40 percent Steedman soil, 30 percent Gowen soil, and 30 percent included soils. The Steedman soil is very gently sloping to sloping and is on convex side slopes. The Gowen soil is nearly level and is on narrow flood plains.

The Steedman soil typically has a surface layer of brown clay loam about 6 inches thick. The subsoil extends to a depth of about 34 inches. The upper 8 inches is brown clay, the next 10 inches is yellowish brown clay, and the lower 10 inches is brownish yellow clay. The underlying material to a depth of 44 inches or more is yellowish brown clay.

The Steedman soil is medium in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is medium. A perched water table is at a depth of 1/2 to 1 foot in winter and spring. Permeability is slow, and surface runoff is rapid. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

The Gowen soil typically has a surface layer of brown loam about 25 inches thick. Below this is grayish brown loam about 35 inches thick. The subsoil extends to a depth of about 72 inches and is brown silt loam.

The Gowen soil is high in natural fertility and organic matter content. Reaction of the surface layer is neutral or mildly alkaline. Available water capacity is high. Permeability is moderate, and surface runoff is slow. The root zone is deep and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Agra, Ashport, Coyle, Easpur, Grainola, Norge, and Pulaski soils and Rock outcrop. Agra soils are on lower side slopes. Ashport, Easpur, and Pulaski soils are in positions similar to that of the Gowen soil and are intermingled with it. Grainola soils are in positions similar to that of the Steedman soil and are intermingled with it. Norge soils are on lower side slopes. Rock outcrops are on lower side slopes. The included soils make up about 30 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this complex are used for range. A few areas are used for tame pasture.

These soils are not suited to cultivated crops. The very severe hazard of erosion, steep slopes, and the hazard of frequent flooding are very difficult to overcome.

Potential for tame pasture and hay is medium. The frequent flooding on the Gowen soil and the very severe hazard of erosion and steep slopes on the Steedman soil make establishment and maintenance of improved grasses and legumes difficult. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to these soils. Using these soils for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

These soils have high potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have medium to high potential for windbreaks and environmental plantings. The dense clay subsoil of the Steedman soil restricts root growth of many of the plants that can be established on this soil. Flooding on the Gowen soil can make establishment of plants difficult.

This complex has medium potential for openland and rangeland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, slow permeability, wetness, slope, and depth to rock are the main limitations of the Steedman soil, but they can usually be overcome by proper design or soil modification. The hazard of flooding on the Gowen soil is a major limitation and is difficult to overcome. Septic tank absorption fields function poorly in the Steedman soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Gowen soil only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIe. The Steedman soil is in Loamy Prairie range site, and the Gowen soil is in Loamy Bottomland range site.

90—Derby fine sandy loam, 15 to 35 percent slopes. This moderately steep to steep, loamy soil is on broad, convex, rolling uplands along the north side of the

Cimarron River. This soil is deep and somewhat excessively drained. Individual areas are irregular in shape and range from 40 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. Below this is 11 inches of light brown loamy fine sand. The subsurface layer is pink fine sand about 34 inches thick. The subsoil extends to a depth of more than 80 inches. The upper 18 inches is reddish yellow fine sand with thin bands of yellowish red fine sand, and the lower 48 inches is pink fine sand with thin bands of yellowish red fine sand.

Natural fertility and organic matter content are low. Reaction of the surface layer ranges from medium acid to mildly alkaline. Available water capacity is low. Permeability is rapid, and surface runoff is very slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Eufaula, Goodnight, and Slaughterville soils. Eufaula soils are on convex side slopes in slightly higher positions than the Derby soil. Goodnight soils are on convex dunes in lower positions than the Derby soil. Slaughterville soils are in concave areas. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for range.

This soil is not suited to cultivated crops or to tame pasture and hay. The very severe hazard of erosion and steep slopes are very difficult to overcome.

This soil has low potential for range. Little bluestem, indiangrass, and sand bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The lack of available water in the subsoil restricts the growth and development of trees.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments is low. Slope, seepage, and poor filtering capacity are the main limitations, but they can usually be overcome by proper design or soil modification. Septic tank absorption fields will function only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass VIIe; Deep Sand Savannah range site.

91—Grainola-Lucien-Shidler complex, 1 to 20 percent slopes. This complex consists of very gently sloping to moderately steep soils on broad, convex ridgetops and side slopes on uplands in the eastern part of Payne County. The Grainola soil is moderately deep and well drained. The Lucien soil is shallow and well drained. The Shidler soil is very shallow to shallow and well drained. Fragments of sandstone and limestone less than 2 feet in diameter cover 15 to 35 percent of the surface of the Grainola soil. Areas of these soils are so intermingled that they could not be shown separately at the scale of mapping. Individual areas of this complex are irregular in shape and range from 10 to 1,000 acres in size.

This complex is 35 percent Grainola soil, 25 percent Lucien soil, 15 percent Shidler soil, and 25 percent included soils. The Grainola soil is on convex side slopes, and the Lucien and Shidler soils are on convex ridgetops and upper side slopes (fig. 14).

The Grainola soil typically has a surface layer of reddish brown stony clay loam about 6 inches thick. The subsoil is reddish brown clay to a depth of about 34 inches. The underlying material to a depth of 40 inches or more is reddish brown shale.

The Grainola soil is medium in natural fertility and organic matter content. Reaction of the surface layer is mildly alkaline or moderately alkaline. Available water capacity is medium. Permeability is slow, and surface runoff is rapid. The root zone is moderately deep, but roots have difficulty penetrating the dense subsoil.

The Lucien soil typically has a surface layer of reddish brown loam about 8 inches thick. The subsoil is reddish brown loam to a depth of about 16 inches. The underlying material to a depth of 23 inches or more is pink sandstone.

The Lucien soil is medium in natural fertility and medium in organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is low. Permeability is moderately rapid, and surface runoff is medium to rapid. The root zone is shallow and can be easily penetrated by plant roots.

The Shidler soil typically has a surface layer of dark brown loam about 6 inches thick. The subsoil is reddish brown clay loam to a depth of about 18 inches. The underlying material is hard, gray, fractured limestone.

The Shidler soil is high in natural fertility and organic matter content. Reaction of the surface layer is slightly acid or neutral. Available water capacity is low. Permeability is moderate, and surface runoff is slow to medium. The root zone is shallow and can be easily penetrated by plant roots.

Included with these soils in mapping are small areas of Ashport, Coyle, Darnell, Masham, Renfrow, and Steedman soils. Ashport soils are below the major soils on narrow, nearly level flood plains along drainage channels. Coyle and Darnell soils are in positions similar to that of the Lucien soil. Masham soils are on steep convex side slopes. Renfrow soils are on lower convex, gently sloping side slopes. Steedman soils are in positions similar to that of the Grainola soil. The included soils make up about 25 percent of the map unit, but individual areas generally are smaller than 5 acres.

Figure 14.—Native grass on Grainola-Lucien-Shidler complex, 1 to 20 percent slopes. The Lucien and Shidler soils are on the ridgetop in the background, and the Grainola soil, which has a stony clay loam surface layer, is on the upper side slopes.

Most areas of this complex are used for range.

These soils are not suited to cultivated crops or to tame pasture and hay. The very severe hazard of erosion, steep slopes, boulders on the surface, and shallow depth to bedrock are limitations that are very difficult to overcome.

These soils have low potential for range. Little bluestem, indiangrass, big bluestem, switchgrass, and sideoats grama are suited to these soils. Controlled grazing, proper stocking rates, and weed and brush control are needed.

These soils have low potential for windbreaks and environmental plantings. The dense clay subsoil of the Grainola soil restricts root growth of many of the plants that can be established on this soil. The shallow depth to rock of the Lucien and Shidler soils also restricts root development. The lack of available water in the subsoil restricts the growth and development of trees.

These soils have medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to these soils.

Potential for sanitary facilities, building sites, and recreational developments is low. Shrinking and swelling, slow permeability, slope, and depth to rock are the main limitations of the Grainola soil. Seepage and depth to rock are the main limitations of the Lucien soil. Depth to rock is the main limitation of the Shidler soil. These limitations can usually be overcome by proper design or soil modification. Septic tank absorption fields function poorly in the Grainola soil, but sewage lagoons are suitable. Septic tank absorption fields will function in the Lucien and Shidler soils only if the soil is extensively modified. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

This complex is in capability subclass VIIs. The Grainola and Lucien soils are in Shallow Prairie range site, and the Shidler soil is in Very Shallow range site.

93—Slaughterville fine sandy loam, 1 to 3 percent slopes. This very gently sloping, loamy soil is on broad, concave to convex ridgetops and side slopes on uplands on the north side of the Cimarron River. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown fine sandy loam about 16 inches thick. The subsoil extends to a depth of about 74 inches. The upper 28 inches is brown grading to light brown sandy loam, and the lower 30 inches is reddish yellow fine sandy loam. The underlying material to a depth of 80 inches or more is red fine sandy loam.

Natural fertility and organic matter content are medium. Reaction of the surface layer ranges from slightly acid to mildly alkaline. Available water capacity is high. Permeability is moderately rapid, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Dougherty, Konawa, Minco, and Teller soils. Dougherty soils are in positions similar to that of the Slaughterville soil. Konawa and Teller soils are on higher, convex ridgetops. Minco soils are on higher, convex side slopes. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Slaughterville soil are used for crops or tame pasture. The principal crops are wheat, alfalfa, and peanuts.

This soil has medium potential for crops. Small grains, row crops, alfalfa, vegetables, fruits, and nuts suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is high. Bermudagrass, weeping lovegrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has high potential for range. Little bluestem, indiangrass, big bluestem, and sideoats grama are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Seepage is the main limitation, but it can be overcome by soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIe; Sandy Prairie range site.

95—Dougherty loamy fine sand, 0 to 3 percent slopes. This nearly level to very gently sloping, sandy soil is on broad, convex ridgetops on uplands generally on the north side of the Cimarron River. This soil is deep and well drained. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is pale brown loamy fine sand about 4 inches thick. The subsurface layer is very pale brown loamy fine sand about 22 inches thick. The subsoil extends to a depth of about 72 inches. The upper 24 inches is yellowish red sandy loam, and the lower 22 inches is reddish yellow fine sandy loam. The underlying material to a depth of 80 inches or more is yellowish red loamy fine sand.

Natural fertility and organic matter content are low. Reaction of the surface layer ranges from strongly acid to slightly acid. Available water capacity is medium. Permeability is moderate, and surface runoff is slow. Tilth is good, and the soil can be worked throughout a wide range in moisture conditions. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Eufaula, Konawa, Slaughterville, and Teller soils. Eufaula soils are on steeper side slopes. Konawa, Slaughterville, and Teller soils are in positions similar to that of the Dougherty soil. The included soils make up about 10 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this soil are used for crops or tame pasture. The principal crops are wheat, grain sorghum, and peanuts.

This soil has low potential for crops. Small grains, row crops, vegetables, fruits, and nuts are suited to this soil. Controlling wind and water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, and residue management help to maintain soil tilth and productivity. Contour farming helps to prevent water erosion.

Potential for tame pasture and hay is medium. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has low potential for range. Little bluestem, big bluestem, and sand bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium to high potential for windbreaks and environmental plantings. There are no major limitations that restrict the choice of plants or their growth.

This soil has high potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Moderate permeability and seepage are the main limitations, but they can be overcome by proper design or soil modification. Septic tank absorption fields function well if properly designed and installed. Onsite investigation is essential.

Capability subclass IIIe; Deep Sand Savannah range site.

96—Doolin silt loam, 0 to 2 percent slopes. This nearly level to very gently sloping, loamy soil is on broad, slightly concave ridgetops on high watershed divides. This soil is deep and moderately well drained. Individual areas are irregular in shape and range from 10 to 150 acres in size.

Typically, the surface layer is grayish brown silt loam about 12 inches thick. The subsoil extends to a depth of about 68 inches. The upper 20 inches is dark brown silty clay loam, the next 16 inches is brown clay loam, and the lower 20 inches is reddish yellow clay loam. The underlying material is strong brown sandstone.

Natural fertility and organic matter content are high. Reaction of the surface layer ranges from medium acid to mildly alkaline. The subsoil is high in sodium. Available water capacity is medium. Permeability is very slow, and surface runoff is slow. Tilth is good, but surface crusting is common. The root zone is deep, but roots have difficulty penetrating the dense subsoil.

Included with this soil in mapping are small areas of Chickasha, Huska, Kirkland, Renfrow, and Zaneis soils. Chickasha, Renfrow, and Zaneis soils are on convex side slopes below the Doolin soil. Huska and Kirkland soils are in positions similar to that of the Doolin soil. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Doolin soil are used for crops or tame pasture. The principal crops are wheat and grain sorghum.

This soil has low to medium potential for crops. Small grains, row crops, and vegetables are suited to this soil. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns in management. A planned system of fertilization, high-residue crops and cover crops, application of gypsum, and residue management help to maintain soil tilth and productivity. Terracing and contour farming help to prevent water erosion.

Potential for tame pasture and hay is low. Bermudagrass, Caucasian and plains bluestem, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, big bluestem, and switchgrass are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has low potential for windbreaks and environmental plantings. The dense clay subsoil restricts root growth of many of the plants that can be established on this soil.

This soil has medium potential for openland wildlife habitat and low potential for rangeland and wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Shrinking and swelling, very slow permeability, and excess sodium are the main limitations, but they can be overcome by proper design or soil modification. Low strength is a limitation for local roads and streets. Septic tank absorption fields function poorly in this soil, but sewage lagoons are suitable. Shrinking and swelling can be overcome on building sites by use of specially designed footings and subgrades. Onsite investigation is essential.

Capability subclass IIIe; Claypan Prairie range site.

97—Goodnight loamy fine sand, 1 to 5 percent slopes. This gently undulating, sandy soil is on convex flood plains along the Cimarron River. It is deep and excessively drained. This soil is subject to damaging floods once in more than 20 years. These floods occur from March through August and last not longer than 24 hours. Individual areas are long and narrow in shape and range from 5 to 150 acres in size.

Typically, the surface layer is light brown loamy fine sand about 10 inches thick. The subsoil is reddish yellow loamy fine sand to a depth of 26 inches. The underlying material is reddish yellow fine sand to a depth of 72 inches or more.

Natural fertility and organic matter content is low. Reaction of the surface layer ranges from neutral to moderately alkaline. Available water capacity is low. Permeability is rapid, and surface runoff is very slow. The root zone is deep and can be easily penetrated by plant roots.

Included with this soil in mapping are small areas of Canadian, Derby, Gaddy, Harjo Variant, Hawley, and Yahola soils. Canadian, Gaddy, Hawley, and Yahola soils are in lower positions on the flood plain. Derby soils are in slightly higher positions on dunes. Harjo Variant soils are in depressional areas in lower positions on the flood plain. The included soils make up about 20 percent of the map unit, but individual areas generally are smaller than 5 acres.

Most areas of this Goodnight soil are used for tame pasture or range.

This soil is not suited to cultivated crops. The very severe hazard of erosion is a limitation that is very difficult to overcome.

Potential for tame pasture and hay is low. Bermudagrass, weeping lovegrass, and other adapted improved grasses and legumes are suited to this soil. Using this soil for tame pasture and hay is effective in controlling erosion. Preventing overgrazing, maintaining fertility, and controlling weed competition are the main management concerns. Proper stocking rates, rotation of grazing, timely deferment of grazing, and weed control help to keep the vegetation and soil in good condition.

This soil has medium potential for range. Little bluestem, indiangrass, and sand bluestem are suited to this soil. Controlled grazing, proper stocking rates, and weed and brush control are needed.

This soil has medium potential for windbreaks and environmental plantings. The lack of available water in the subsoil restricts the growth and development of trees.

This soil has medium potential for openland and rangeland wildlife habitat and low potential for wetland wildlife habitat. Grain and seed plants, grasses and legumes, and wild herbaceous plants are suited to this soil.

Potential for sanitary facilities, building sites, and recreational developments ranges from low to high. Seepage and poor filtering capacity are limitations, but they can be overcome by proper design or soil modification. The hazard of rare flooding is a major limitation and is difficult to overcome. Septic tank absorption fields will function properly only if the soil is extensively modified. Onsite investigation is essential.

Capability subclass VIe; Deep Sand Savannah range site.

98—Pits, quarries. This land type consists of areas from which the soil has been removed in mining limestone and the areas where the soil was stockpiled during mining.

In most areas the parent material is exposed. Some areas are covered with more than 5 feet of overburden. Exposed parent material consists of intermixed weathered shale and limestone.

Little or no vegetation has become established in most quarry locations. Reclamation is possible in most areas, but is very expensive. Native grasses and improved pasture grasses can be established on reclaimed areas with proper management.

Not assigned to a capability subclass or range site.

99—Oil-waste land. This land type consists of areas on uplands where well-drilling operations have altered the surrounding soils. Liquid wastes from drilling, principally oil and salt water, have been deposited near the well. Oil-waste land is found in all parts of the county. Areas are usually 3 to 10 acres in size, but can be as large as 25 acres. Slope ranges from 0 to 3 percent.

Surface runoff is rapid, and erosion is a severe hazard.

Oil-waste land is not suitable for agricultural uses. Very little vegetation grows in these areas. Some salt-tolerant grasses have become established during wet seasons.

Capability subclass VIIIs; not assigned to a range site.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Payne County are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 5 percent.

The following map units, or soils, make up prime farmland in Payne County, Oklahoma. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use. About 126,195 acres, or nearly 28 percent, of Payne County meets the soil requirements for prime farmland. Most areas of prime farmland are used for pasture and crops.

Soils that have limitations, such as a high water table or flooding, may qualify as prime farmland if these limitations are overcome by such measures as drainage or flood control. In the following list, the measures needed to overcome the limitations of a map unit, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to determine if the limitations have been overcome by the corrective measures.

2	Coyle loam, 1 to 3 percent slopes
3	Coyle loam, 3 to 5 percent slopes
5	Bethany silt loam, 0 to 2 percent slopes
8	Chickasha loam, 1 to 3 percent slopes
9	Chickasha loam, 3 to 5 percent slopes
12	Agra silt loam, 1 to 3 percent slopes
13	Agra silt loam, 3 to 5 percent slopes
20	Slaughterville fine sandy loam, 3 to 6 percent slopes
21	Kirkland silt loam, 0 to 2 percent slopes
22	Konawa fine sandy loam, 3 to 5 percent slopes
24	Konawa fine sandy loam, 1 to 3 percent slopes
27	Asher silty clay loam, rarely flooded
29	Minco very fine sandy loam, 1 to 3 percent slopes
30	Minco very fine sandy loam, 3 to 5 percent slopes
31	Harrah fine sandy loam, 3 to 5 percent slopes
33	Norge loam, 1 to 3 percent slopes
34	Norge loam, 3 to 5 percent slopes
36	McLain silt loam, rarely flooded
37	Port silt loam, occasionally flooded
38	Navina loam, 0 to 1 percent slopes
41	Easpur loam, occasionally flooded
42	Ashport silty clay loam, occasionally flooded
43	Pulaski fine sandy loam, occasionally flooded
44	Canadian fine sandy loam, rarely flooded
45	Renfrow silt loam, 1 to 3 percent slopes
46	Renfrow silt loam, 3 to 5 percent slopes
53	Stephenville fine sandy loam, 1 to 3 percent slopes

54 Stephenville fine sandy loam, 3 to 5 percent slopes
55 Teller loam, 0 to 1 percent slopes
56 Teller fine sandy loam, 1 to 3 percent slopes
57 Teller loam, 1 to 3 percent slopes
58 Teller loam, 3 to 5 percent slopes
60 Mulhall loam, 3 to 5 percent slopes
64 Navina loam, 1 to 3 percent slopes
65 Grainola clay loam, 3 to 5 percent slopes
68 Yahola fine sandy loam, occasionally flooded
69 Zaneis loam, 1 to 3 percent slopes
70 Zaneis loam, 3 to 5 percent slopes
73 Dale silt loam, rarely flooded
84 Hawley fine sandy loam, rarely flooded, undulating
93 Slaughterville fine sandy loam, 1 to 3 percent slopes

Use and Management of the Soils

Donald L. Jackson, district conservationist, Soil Conservation Service, helped to prepare this section.

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 for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other 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 that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Keith Vaughn, state conservation agronomist, and David E. Legg, range conservationist, Soil Conservation Service, helped to prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants 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 hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Crops

Farmers in Payne County can use a wide variety of cropping systems. Several crops are produced and marketed, as well as a variety of improved pasture plants. Each crop and each kind of pasture needs slightly different management in order to produce the highest yields while still maintaining the soil in a manner that will keep it productive over the years.

About 22 percent of the county is cultivated. Wheat is the principal crop and is grown county wide. Alfalfa is the second leading crop in the county and is grown mainly on bottom land soils and on deep loamy upland soils of the Teller, Norge, Konawa, Navina, Slaughterville, and Minco series. Soybeans are grown primarily in the eastern part of the county on loamy bottom land soils and on upland soils that have a clayey subsoil. Peanuts are grown in bottom land areas of Pulaski soils and on upland areas of Teller, Minco, Slaughterville, Konawa, Navina, and Dougherty soils. Grain and forage sorghums are grown mainly in bottom land areas of Port, Ashport, Easpur, and Pulaski soils. There are no commercial fruit orchards in Payne County, but peach, apple, and pear trees produce well on Konawa, Teller, Navina, Dougherty, Slaughterville, and Minco soils. There are some commercial pecan orchards on Ashport, Easpur, Port, and Pulaski soils.

Cultivated soils need management that conserves moisture, controls erosion, maintains fertility, supplies organic matter, removes excess surface water, and provides good tilth. Most management practices accomplish more than one purpose and can be used on cropland throughout the county.

Excessive tillage damages soils by breaking down the soil structure and promoting the rapid decomposition of organic matter. The soils then tend to puddle and crust on the surface, take in less water and air, and store less water for plant growth. The thick surface crust also inhibits the emergence of seedlings, resulting in poor stands. Conservation tillage leaves additional vegetative residue on the surface. Conservation tillage can be accomplished by using chisel or sweep plows to kill weeds and to prepare the seedbed rather than clean tillage with a moldboard plow. Chemical weed control can also be used to maintain a weed-free field until planting. Green-manure crops, such as cowpeas or Austrian winter peas, increase soil fertility and organic matter content and improve soil tilth. Gypsum may improve water infiltration and reduce surface crusting on soils that have excessive sodium salts in the subsoil, such as Doolin, Huska, Oscar, and Seminole soils.

Control of erosion is very important. Erosion, particularly sheet and rill erosion, is damaging for two reasons. First, productivity is reduced as the surface layer becomes thinner and part of the subsoil is incorporated into the plow layer. This is especially damaging on soils that have a clayey subsoil, such as Renfrow, Huska, and Agra soils, where poor tilth and loss of organic matter promote poor water infiltration and poor stands. Shallow or moderately deep soils, such as Lucien, Coyle, and Stephenville soils, show the effects of sheet erosion by losing available water capacity and rooting depth. Second, soil erosion results in pollution of streams by sediment, soil nutrients, and chemicals. Controlling pollution improves the quality of water for municipal consumption, for recreation, and for fish and wildlife.

Practices that effectively control erosion in Payne County are conservation tillage, contour farming, terraces, grassed waterways, and cropping systems that provide maximum soil cover during the critical erosion period from early spring through late fall.

Close-growing crops, such as wheat, provide more control on sloping upland soils than do row crops, such as peanuts, soybeans, or grain sorghum. When row crops are grown on sloping soils they should always be planted on the contour.

Terraces are useful on sloping soils. They reduce the slope length and prevent the water from reaching an erosive velocity. Properly designed terraces release the water into a grassed waterway or pasture where it will not cause additional erosion.

Dougherty, Derby, Konawa, and Slaughterville soils are deep and sandy and are commonly found along the north side of the Cimarron River. These soils are generally unsuitable for terracing, so cropping systems that make maximum use of residue are needed. If these soils are cropped to peanuts, a cover crop is needed. If these soils are used for wheat, soil blowing can be a problem. Stripcropping with forage sorghum reduces wind erosion in such areas.

Soils on bottom lands in the county are subject to damage from flooding and ponding. Ashport, Dale, Easpur, Port, and Pulaski soils generally need diversions to intercept water flowing from higher lying areas. Ashport, Asher, and Harjo Variant soils often have ponded water, which can be removed by surface drainage if a suitable outlet can be found.

Pasture

About 25 percent of Payne County is tame pasture. Much of the marginal land that was formerly used for crops has been put back to grass.

Bermudagrass is the most extensive tame pasture grass grown in the county, and it will grow on most soils in this area. Weeping lovegrass has been planted on many of the sandy soils, where it usually outproduces bermudagrass. There has been an increasing use of Caucasian and plains bluestem, and they may become extensive. There has not been a great amount of success with cool-season perennial grasses, such as fescue or wheatgrass, because the droughty summers tend to diminish the stand in all areas except wet bottom lands.

Legumes, such as arrowleaf clover and yellow hop clover, have been successful when overseeded on bermudagrass pastures on bottom lands and loamy uplands. Sericea lespedeza and sweetclover have been successfully planted on eroded soils and clayey soils and provide some measure of erosion control.

Bermudagrass is grown extensively throughout the county. In upland areas, Greenfield bermudagrass seems to cover the ground more quickly and tolerate droughty conditions better than Midland bermudagrass. Midland will usually outproduce Greenfield on loamy and sandy bottom lands of Easpur, Pulaski, Yahola, Gaddy, and Port soils and on uplands of Konawa, Dougherty, Teller, Slaughterville, Norge, and Minco soils. On Renfrow, Zaneis, Coyle, Kirkland, Doolin, Huska, Agra, and other soils that have a clayey subsoil, Greenfield bermudagrass seems to cover more quickly and outproduce Midland. Greenfield also does well in eroded areas and other critical areas where a cover is needed quickly.

Some areas of cropland are used for forage to supplement the permanent grasses. Small grains provide grazing and additional protein for livestock late in fall and in spring. Small grains should be seeded and fertilized late in summer or early in fall in order to produce the maximum amount of forage. Small grains can be grazed until mature, or livestock can be removed in spring to allow the plants to produce a seed crop for harvest. Wheat, oats, barley, and rye are the main small grains used for grazing.

Forage sorghum, an annual grass, is also grown to supplement permanent grasses. Forage sorghum can be used in the pasture program to provide grazing during summer, or it can be harvested for hay. In some areas, forage sorghum is allowed to grow until frost and is grazed in winter. Fertilizer should be applied for maximum growth.

The kinds of soil and the plants grown must be considered in the management of tame pasture. Good pasture is achieved by maintaining the desired stand of forage plants. Plants must have vigor to keep the proper balance in the stand. The grazing program should be compatible with the growth cycle of the plants.

Proper grazing and rotation grazing are necessary for all pasture grasses in order to maintain the stand and produce the maximum amount of forage. These practices also lengthen the life of most tame pasture plants. Deferring grazing while tame pasture plants are under the greatest stress allows them to regain vigor by maintaining a large root system where food can be stored for the next growing season. The grasses should be allowed to produce additional growth before they go dormant in fall so that they can accumulate maximum root reserve. Such a reserve helps to prevent winterkill and insures production early in spring. Total production of forage will increase.

Fertilizer containing the proper elements increases the vigor of pasture plants. Fertilizing increases the amount of forage and lengthens the life of the stand. Commercial fertilizer or legumes, or both, can be used to furnish nitrogen to the plants. Large amounts of fertilizer, especially nitrogen, are needed if legumes are not grown with the grasses. The reaction of the soil should be adjusted to the kinds of plants desired in the stand.

Desirable pasture plants can be maintained in the stand only if invasion by undesirable plants is prevented. Brush control is essential on soils that support trees. Weeds and brush can be controlled by mowing or by chemicals. Legumes in the stand can be damaged by chemicals unless care is taken.

Bermudagrass should be fertilized with split applications of 75 pounds of actual nitrogen every 21 days, providing moisture is available. If bermudagrass has been overseeded with arrowleaf clover or yellow hop clover, the first application of nitrogen in the spring should be reduced to about 30 pounds to allow the clover to compete and produce a seed crop. Cross-fencing and rotation of the pastures are necessary for maximum utilization of the available grass.

Weeping lovegrass has been planted on sandy and droughty soils, many of which were formerly in oak timber. Lovegrass provides an excellent source of forage early in spring before the bermudagrass begins to grow. For maximum production, lovegrass should be fertilized early in spring, and cattle should be rotated from one pasture to the next every 14 to 21 days in order to keep the grass from getting so mature that cattle will not effectively graze it. Lovegrass stands have not been very successful on soils having a clayey subsoil, such as Renfrow and Agra soils, nor on flood plains where it is easily drowned out.

Caucasian and plains bluestem have been successfully established on clayey and loamy soils where bermudagrass has difficulty. Bluestem does not establish well on soils that have a sandy surface layer. These grasses provide excellent grazing in summer. They should be fertilized with about 75 pounds of actual nitrogen in spring and again about 60 days later, providing there is adequate moisture.

A grazing program can be so planned that forage will be available during every month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage each month. The patterns of growth of various forage plants are graphed in figure 15. For example, bermudagrass makes 28 percent of its yearly forage growth during June.

Soils vary in their capacity to produce forage for grazing. Teller soils produce more forage than Lucien soils primarily because they furnish more moisture to the plants. The total yearly production of common pasture plants for each soil is given in animal-unit-months (AUM) in table 5. For example, one acre of bermudagrass on Teller loam, 1 to 3 percent slopes, will furnish grazing for one animal-unit for 7 months each year.

In planning a pasture program, one must consider the total yearly production of the plants and the growth they will make in each month (fig. 15). For example, bermudagrass produces 28 percent of its annual growth during June. Yearly production on Teller loam, 1 to 3 percent slopes, is 7 AUM. Since 28 percent of 7 AUM is 2 AUM, one acre of the Teller soil will provide grazing for 2 animals in June. Therefore, a 50-acre pasture would provide grazing for 100 animals during June. Personnel of the Soil Conservation Service or the Extension Service can help in planning a pasture program.

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

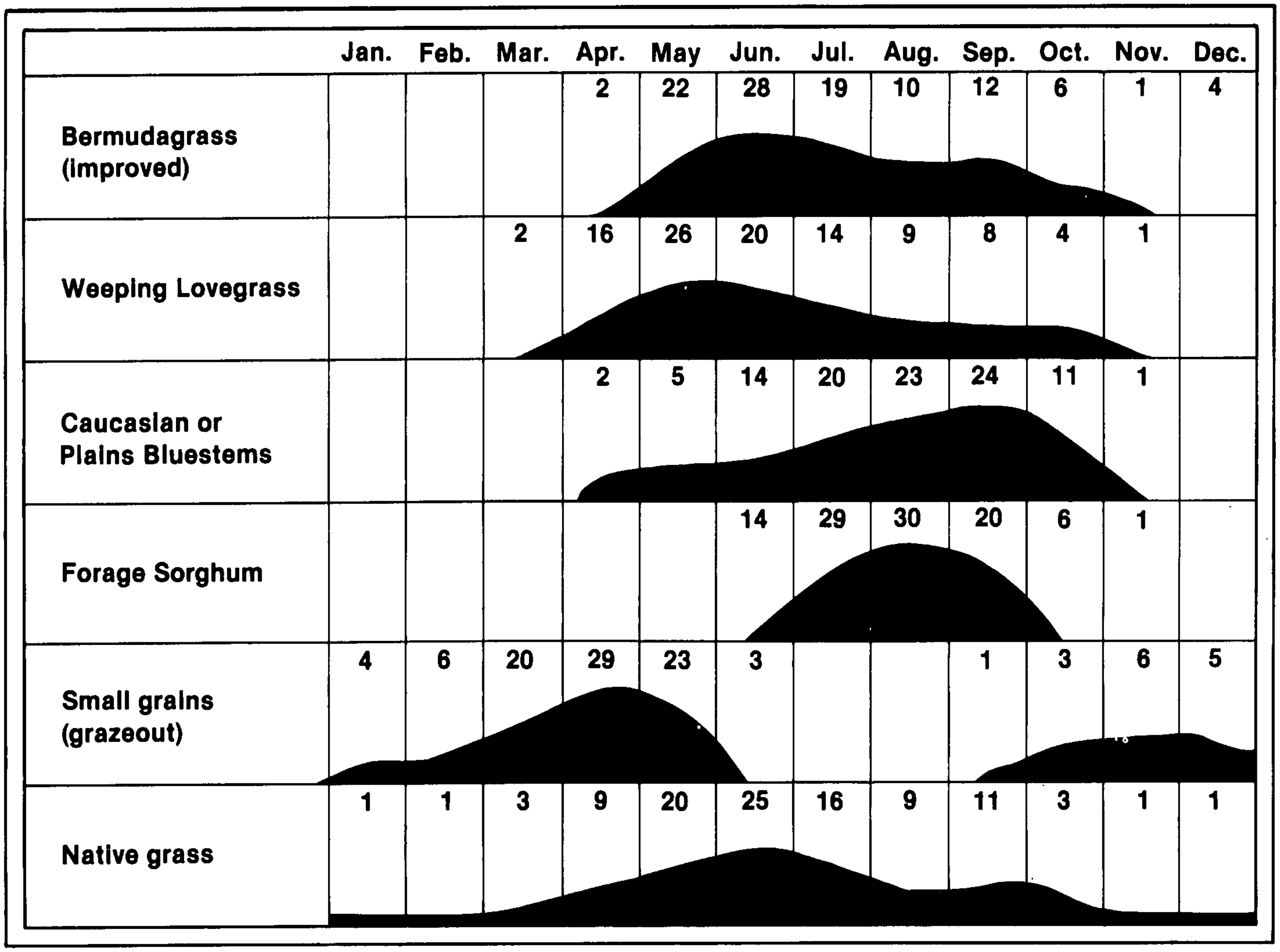


Figure 15.—Distribution of annual growth of major pasture plants.

residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

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 for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode, but they 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 a 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, saline or alkali-affected; 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.

There are no subclasses in class I because the soils of this class have few limitations. The soils in class V are subject to little or no erosion, but they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation. Class V contains only the subclasses indicated by *w, s,* or *c.*

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Harry L. Fritzler and Ernest C. Snook, range conservationists, Soil Conservation Service, helped to prepare this section.

Rangeland is land on which the native vegetation is grasses, grasslike plants, forbs, shrubs, and trees. The plants are generally suitable for grazing and occur in sufficient amount to be used for grazing. The composition and production of the plant community is determined by soil, climate, topography, and grazing management.

Fifty percent of Payne County is rangeland. The range vegetation consists of a wide variety of native grasses interspersed with an abundance of forbs.

Four distinct types of rangeland exist in Payne County. In the eastern part of the county most of the soils are loamy and are deep to shallow over shale, clayey sediment, sandstone, or limestone. These soils support tall and mid grasses, and potential productivity is high. In much of the western part of the county, the soils are loamy and are shallow to moderately deep over shale or sandstone. There are large areas of steep slopes and escarpments. These areas support tall, mid, and short grasses, and potential productivity is low because of shallow rooting depth and low available water. Along the north side of the Cimarron River the soils are sandy and are deep over sandy sediment. There are areas of hummocks, and soil blowing is a hazard. These soils support trees (oak primarily) and tall grasses, and potential productivity is much greater than on the shallow soils. Many of these areas were once cultivated but have reverted naturally or been reseeded to native grasses. In the north-central part of the county, the soils are loamy and are shallow to deep over shale and soft sandstone. These areas support mid and tall grasses, and potential productivity is high.

The plant community on Payne County rangeland has changed drastically over the past 50 years. Heavy grazing has eliminated much of the high-quality vegetation. Now, tall grasses flourish in only a few places. Areas that were once open rangeland are now covered with post oak and blackjack oak, a mixture of tall to mid grasses, and poor-quality forbs. The amount of forage presently produced may be less than half of that originally produced. However, remnants of the original plant species are still found in protected areas on most sorts of rangeland, and in most cases good grazing management will allow these high-quality plants to reestablish themselves.

Most of the local ranches and livestock farms are cow-calf operations. These are some stocker enterprises, and many ranches supplement their cow herds with stockers to provide greater flexibility in adjusting the number of livestock.

Approximately 75 percent of the annual forage production on rangeland takes place in April, May, and June when spring rains and moderate temperatures are favorable for the growth of warm-season plants. A secondary growth period generally occurs in September and October when fall rains and gradually cooling temperatures are common.

Livestock operations generally supplement the grazing of native grassland with the grazing of improved pasture and certain crops. Improved bermudagrass and weeping lovegrass are commonly grown on pasture. Protein supplements, hay, and small grain crops are used to feed livestock through winter.

Droughts of varying length are frequent in this area. Short midsummer droughts are normal. Longer periods of drought, lasting several months, are frequent.

Range Sites and Condition Classes

A range site is a distinctive kind of range that produces a characteristic climax, or potential, plant community that differs from the plant communities on other range sites in kind, amount, and proportion of range plants. The relationships between soils and vegetation were established during this soil survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

The climax vegetation of a range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing there when the region was first settled. Under good management this plant community reproduces itself and changes very little as long as the environment remains unchanged. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are the plants in the climax community that are preferred by livestock for grazing. They tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock. Increasers are less desirable plants that increase in relative amount as the more desirable decreaser plants are reduced. They are commonly shorter than decreasers and are generally less palatable to livestock. Invaders are undesirable plants that normally cannot compete with the plants in the climax community for moisture, nutrients, and light. However, invaders grow along with the increasers after the climax vegetation has been reduced in grazing value. Some invaders have little value for grazing.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site. Four range condition classes are used to indicate the degree of departure from the potential, or climax, community. The classes show the present condition of the vegetation on a range site as compared to the native vegetation that could grow there. An area of range is in excellent condition if 76 to 100 percent of the vegetation is the same as the climax stand; in good condition if 51 to 75 percent; in fair condition if 26 to 50 percent; and in poor condition if 25 percent or less.

Potential forage production depends on the range site. Current forage production depends also on the range condition, plant vigor, and moisture available to plants during the growing season. Potential annual production is the amount of vegetation that can be expected to grow every year on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. The growth on woody plants is not generally usable by livestock.

Table 6 shows, for each soil, the range site and the potential annual production of vegetation. Only those soils that are used for or are suited to range are listed. Potential annual production is given in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and temperature make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

A primary objective of range management is keeping range in excellent or good condition. Good range management conserves water, improves yields, and protects the soils. The main management concern is recognizing important changes in the plant cover. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, whereas actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some kinds of range, if closely grazed for short periods under the supervision of a careful manager, can have a degraded appearance that temporarily conceals its quality and ability to recover.

Following years of prolonged overuse of rangeland, seed sources of the desirable plants will be eliminated. When this happens, the vegetation needs to be reestablished for management to be effective.

Range management practices suitable for Payne County are proper grazing use, deferred grazing, and planned grazing systems. Also beneficial are stock-water development, fencing, and controlled distribution of salt and feed. After undesirable plants have become dominant, range seeding, brush management, and prescribed burning should be considered.

Properly applied and maintained, these practices generally result in optimum production of vegetation, reduction of undesirable species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and adequately protects soil and water resources.

The quality and quantity of native vegetation can be maintained or improved by controlled grazing. The amount of forage that can be grazed depends on the potential productivity and condition of the site. As a rule, about 50 percent of the annual growth of vegetation should be left after the grazing season. One-third of the height of tall and mid grasses equals about 50 percent of the annual production at maturity. Fifty percent of the annual growth remaining on the site will protect the soil and plants. The dispensable 50 percent may or may not be removed from the site, and it can be removed in a number of ways besides livestock grazing—by rodents, insects, and wildlife, and by deterioration due to climatic variation. Generally, livestock can graze approximately 25 percent of the total annual growth by weight.

For example, production on the Loamy Prairie range site in excellent condition for an average season is 3,500 pounds of air-dry plant material (table 6). This 3,500 pounds includes all production of grasses, forbs, and woody species. Livestock can graze approximately 25 percent of this: 875 pounds.

A 1,000-pound cow is equivalent to one animal-unit (AU) and will consume 2-1/2 to 3 percent of her body weight—25 to 30 pounds—of forage per day; so in one month an animal-unit will consume 750 to 900 pounds of native vegetation, mainly grass, depending on the quality and state of growth of the plants.

Dividing 875 pounds (available forage) by 25 to 30 pounds (forage required per day for one animal-unit) shows that one acre of Loamy Prairie range site in excellent condition will feed one cow for 29 to 35 days. To convert forage available from one acre to animal-unit-months (AUM), the available forage (875 pounds) is divided by the amount required to feed an animal-unit for one month (750 to 900 pounds). One acre will provide 0.97 to 1.16 AUM of grazing. Therefore, 10.34 to 12.37 acres of Loamy Prairie range site in excellent condition is required to feed one cow for 12 months.

More information for planning a grazing program is available from the local office of the Soil Conservation Service.

Descriptions of the Range Sites

Nineteen range sites are recognized in Payne County. The following descriptions list the plants that are characteristic of the sites in good condition and under the stress of excessive grazing. The soils in each site are also indicated.

Alkali Bottomland range site

This range site consists of Oscar soils in map unit 39. This short- and mid-grass community is 75 percent grasses and 25 percent forbs.

Switchgrass, little bluestem, sideoats grama, western wheatgrass, blacksamson, pitcher sage, and perennial lespedeza are preferred by livestock. These plants make up 65 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as meadow dropseed, alkali sacaton, Texas dropseed, bitter sneezeweed, blue grama, buffalograss, goldenrod, and prairie coneflower.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as threeawn, ragweed, curlycup gumweed, pricklypear, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Claypan Prairie range site

This range site includes Agra, Doolin, Kirkland, Seminole, and Renfrow soils in map units 12, 13, 14, 21, 45, 46, 47, 78, 79, and 96. This mid- and tall-grass community is 80 percent grasses, 15 percent forbs, and 5 percent woody plants.

Big bluestem, little bluestem, indiangrass, switchgrass, leadplant, bundleflower, compassplant, and perennial sunflowers are preferred by livestock. These plants make up 70 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as sideoats grama, blue grama, buffalograss, fall witchgrass, wild alfalfa, dotted gayfeather, heath aster, goldenrod, and prairie coneflower.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as annual threeawn, silver bluestem, ragweed, croton, pricklypear, curlycup gumweed, partridgepea, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Deep Savannah range site

This range site includes Derby, Dougherty, Eufaula, Goodnight, and Konawa soils in map units 15, 17, 23, 59, 63, 82, 83, 90, 95, and 97. This tall-grass community is 50 percent grasses, 25 percent forbs, and 25 percent woody plants.

Big bluestem, sand bluestem, indiangrass, little bluestem, switchgrass, broadleaf uniola, perennial lespedeza, tickclover, and hairy sunflower are preferred by livestock. These plants make up 80 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as purpletop, tall dropseed, Scribner panicum, sand lovegrass, wild alfalfa, heath aster, goldenrod, hickory, post oak, red oak, blackjack oak, redbud, and sumac.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as splitbeard bluestem, showy partridgepea, ragweed, white snakeroot, annual threeawn, witchgrass, persimmon, redcedar, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Eroded Clay range site

This range site includes Agra, Seminole, and Renfrow soils in map units 49, 50, and 77. This short- and mid-grass community is 65 percent grasses and 35 percent forbs.

Buffalograss, blue grama, sideoats grama, little bluestem, prairie-clover, yellow neptunia, and perennial sunflowers are preferred by livestock. These plants make up 60 percent of the forage production when the site is in excellent condition. The preferred plants disappear first under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as dropseed, hairy grama, windmillgrass, Scribner panicum, dalea, scurfpea, and goldenrod.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as annual threeawn, Japanese brome, little barley, silver bluestem, splitbeard bluestem, showy partridgepea, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Eroded Prairie range site

This range site includes Chickasha, Coyle, Grainola, Mulhall, and Zaneis soils in map units 49, 50, 62, 76, and 77. Most areas of this site have been cultivated. This mid- and tall-grass community is 65 percent grasses and 35 percent forbs.

Little bluestem, indiangrass, prairie-clover and perennial sunflowers, along with some big bluestem and switchgrass, are preferred by livestock. These plants make up 60 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as meadow and tall dropseed, hairy grama, sideoats grama, Scribner panicum, scurfpea, and dalea.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as splitbeard bluestem, silver bluestem, annual threeawn, perennial threeawns, windmillgrass, ragweed, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Eroded Sandy Savannah range site

This range site includes Konawa and Stephenville soils in map units 51 and 75. Most areas of this site have been cultivated. This tall-grass community is 65 percent grasses, 25 percent forbs, and 10 percent woody plants.

Little bluestem, indiangrass, big bluestem, switchgrass, wildrye, and sand lovegrass are preferred by livestock. These plants make up 50 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as sideoats grama, hairy grama, tall and meadow dropseed, Scribner panicum, purpletop, purple lovegrass, wild alfalfa, and prairie coneflower.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as annual threeawn, splitbeard bluestem, silver bluestem, little barley, witchgrass, sandbur, broomsedge bluestem, red lovegrass, western ragweed, persimmon, post oak, redcedar, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Heavy Bottomland range site

This range site consists of Harjo Variant soils in map unit 28. This mid- and tall-grass community is 70 percent grasses, 20 percent forbs, and 10 percent woody plants.

Big bluestem, indiangrass, switchgrass, prairie cordgrass, little bluestem, eastern gamagrass, wildrye, Florida paspalum, leadplant, perennial lespedeza, compassplant, wholeleaf rosinweed, and Maximilian sunflower are preferred by livestock. These plants make up 65 percent of livestock forage production, when the site is in excellent condition. The preferred plants disappear first under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as tall dropseed, sideoats grama, Scribner panicum, meadow dropseed, longspike tridens, beaked panicum, and scurfpea.

Continued overgrazing and extreme climate conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as windmillgrass, tumblegrass, silver bluestem, buffalograss, threeawn, inland saltgrass, barnyardgrass, curly dock, smartweed, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Loamy Bottomland range site

This range site consists of Asher, Ashport, Canadian, Dale, Easpur, Gowen, Hawley, McLain, Port, Pulaski, and Yahola soils in map units 6, 27, 32, 36, 37, 39, 40, 41, 42, 43, 44, 68, 73, 84, and 87. This tall-grass community is 80 percent grasses, 15 percent forbs, and 5 percent woody plants.

Big bluestem, indiangrass, switchgrass, little bluestem, eastern gamagrass, Florida paspalum, prairie cordgrass, wildrye, leadplant, compassplant, and Maximilian sunflower are preferred by livestock. These plants make up 75 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as tall and meadow dropseed, sideoats grama, buffalograss, Scribner panicum, longspike tridens, beaked panicum, wild alfalfa, and greenbrier.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as silver bluestem, fall witchgrass, threeawn, partridgepea, ragweed, curly dock, ironweed, persimmon, roughleaf dogwood, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Loamy Prairie range site

This range site includes Bethany, Chickasha, Coyle, Minco, Mulhall, Navina, Norge, Steedman, Teller, and Zaneis soils in map units 2, 3, 4, 5, 7, 8, 9, 29, 30, 33, 34, 35, 38, 52, 55, 56, 57, 58, 59, 60, 61, 64, 69, 70, 71, 72, 74, and 87. This mid- and tall-grass community is 75 percent grasses, 20 percent forbs, and 5 percent woody plants.

Big bluestem, little bluestem, indiangrass, switchgrass, leadplant, compassplant, pitcher sage, and perennial sunflowers are preferred by livestock. These plants make up 75 percent of the forage production when this site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as sideoats grama, blue grama, tall and meadow dropseed, Scribner panicum, longspike tridens, wild alfalfa, yellow neptunia, and wild indigo.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as broomsedge bluestem, silver bluestem, splitbeard bluestem, tumblegrass, annual threeawn, broomweed, western ragweed, persimmon, plum, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Red Clay Prairie range site

This range site consists of Masham soils in map unit 48 and 66. This mid- and short-grass community is 70 percent grasses, 28 percent forbs, and 2 percent woody plants.

Little bluestem, big bluestem, indiangrass, switchgrass, Illinois bundleflower, and halfshrub sundrop are preferred by livestock. These plants make up 50 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as sideoats grama, blue grama, hairy grama, buffalograss, tall and meadow dropseed, purple lovegrass, bigtop dalea, prairie-clover, Illinois bundleflower, goldenrod, and sumac.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as threeawn, windmillgrass, Japanese brome, little barley, puffsheath dropseed, showy partridgepea, broomweed, silverleaf nightshade, curlycup gumweed, western ragweed, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Sandy Bottomland range site

This range site consists of Gaddy soils in map units 18 and 19. This tall-grass community is 75 percent grasses, 20 percent forbs, and 5 percent woody plants.

Switchgrass (both bottom land and upland varieties), sand bluestem, indiangrass, little bluestem, prairie cordgrass, big sandreed, Illinois bundleflower, and Maximilian sunflower are preferred by livestock. These plants make up 60 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable plants such as tall and meadow dropseed, sand paspalum, beaked panicum, sideoats grama, wild senna, queensdelight, sand plum, and skunkbush.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as sand dropseed, silver bluestem, fall witchgrass, red lovegrass, windmillgrass, threeawn, sandbur, purple sandgrass, ragweed, ironweed, greenbrier, tamarisk, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Sandy Prairie range site

This range site consists of Slaughterville soils in map units 20, 67, 82, and 93. This tall-grass community is 80 percent grasses, 15 percent forbs, and 5 percent woody plants.

Little bluestem, sand bluestem, switchgrass, indiangrass, wildrye, sand lovegrass, sessileleaf tickclover, slender lespedeza, pitcher sage, and halfshrub sundrop are preferred by livestock. These plants make up 70 percent of the forage production when the site is in excellent condition. The preferred plants disappear first under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as sideoats grama, blue grama, hairy grama, purpletop, Scribner panicum, sand paspalum, tall dropseed, purple lovegrass, wild indigo, wild alfalfa, sand plum, sumac, and skunkbrush.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as silver bluestem, windmillgrass, tumblegrass, red lovegrass, little barley, threeawn, witchgrass, sand dropseed, sandbur, partridgepea, western ragweed, nightshade, oak, hickory, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Sandy Savannah range site

This range site includes Konawa, Harrah, and Stephenville soils in map units 11, 22, 24, 31, 32, 53, and 54. This tall-grass community is 70 percent grasses, 15 percent forbs, and 15 percent woody plants.

Little bluestem, big bluestem, indiangrass, switchgrass, sand lovegrass, wildrye, leadplant, tephrosia, tickclover, sensitivebrier, perennial lespedeza, and perennial sunflowers are preferred by livestock. These plants make up 60 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as tall dropseed, sideoats grama, sand paspalum, Scribner panicum, purple lovegrass, wild indigo, wild alfalfa, redbud, and sumac.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as broomsedge bluestem, splitbeard bluestem, threeawn, sandbur, partridgepea, yarrow, ragweed, snake cotton, persimmon, hawthorn, hickory, post oak, blackjack oak, ash, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Shallow Claypan range site

This range site consists of Huska soils in map units 72 and 81. This short- and mid-grass community is 65 percent grasses and 35 percent forbs.

Little bluestem, switchgrass, tall dropseed, big bluestem, sideoats grama, Illinois bundleflower, and dotted gayfeather are preferred by livestock. These plants make up 55 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as blue grama, buffalograss, longspike tridens, meadow dropseed, fall witchgrass, Scribner panicum, wild alfalfa, wild indigo, heath aster, sagewort, and prairie coneflower.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as threeawn, windmillgrass, tumblegrass, little barley, partridgepea, ironweed, yarrow, pricklypear, curlycup gumweed, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Shallow Prairie range site

This range site includes Grainola and Lucien soils in map units 25, 26, 40, 52, 65, 74, and 91. This mid- and tall-grass community is 75 percent grasses, 20 percent forbs, and 5 percent woody plants.

Little bluestem, big bluestem, indiangrass, switchgrass, tephrosia, sensitivebrier, leadplant, perennial sunflowers, and compassplant are preferred by livestock. These plants make up 65 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as tall and meadow dropseed, sideoats grama, blue grama, hairy grama, Scribner panicum, longspike tridens, wild indigo, scurfpea, prairie coneflower, and sumac.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease as the plant community deteriorates, undesirable plants such as splitbeard bluestem, annual threeawn, little barley, windmillgrass, tumblegrass, partridgepea, ragweed, yarrow, ironweed, persimmon, oak, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Shallow Savannah range site

This range site consists of Darnell soils in map units 10 and 11. This mid- and tall-grass community is 65 percent grasses, 20 percent forbs, and 15 percent woody plants.

Little bluestem, big bluestem, indiangrass, switchgrass, perennial lespedeza, tickclover, tephrosia, and hairy sunflower are preferred by livestock. These plants make up 60 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as tall dropseed, sideoats grama, Scribner panicum, sand paspalum, purple lovegrass, hairy grama, wild indigo, wild alfalfa, heath aster, sagewort, sumac, post oak, blackjack oak, hickory, greenbrier, and redbud.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as splitbeard bluestem, windmillgrass, threeawn, puffsheath dropseed, witchgrass, partridgepea, ragweed, yarrow, ironweed, snake cotton, persimmon, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Subirrigated (moderately saline) range site

This range site consists of Gracemore soils in map unit 19. This tall-grass community is 80 percent grasses, 15 percent forbs, and 5 percent woody plants.

Switchgrass, sand bluestem, little bluestem, indiangrass, prairie cordgrass, wildrye, bundleflower, perennial sunflowers, and wild grape are preferred by livestock. These plants make up 75 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as western wheatgrass, alkali sacaton, tall and meadow dropseed, Scribner panicum, knotroot bristlegrass, willow baccharis, buttonbush, seacoast sumpweed, and smartweed.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as inland saltgrass, silver bluestem, threeawn, ragweed, kochia, ironweed, tamarisk, cottonwood, roughleaf dogwood, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Very Shallow Range Site

This range site consists of Shidler soils in map units 52 and 91. This short-grass community is 70 percent grasses, 25 percent forbs, and 5 percent woody plants.

Buffalograss, blue grama, hairy grama, sideoats grama, sensitive brier, prairie-clover, and willowleaf sunflower are preferred by livestock. Some big bluestem, little bluestem, indiangrass, and switchgrass grow in pockets of deeper soil. These preferred plants make up 75 percent of the forage production when the site is in excellent condition. The preferred plants disappear under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as Scribner panicum, meadow and tall dropseed, fall witchgrass, silver bluestem, wild indigo, surfpea, bigtop dalea, heath aster, dotted gayfeather, sagewort, pricklypear, and sumac.

Continued overgrazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as little barley, hairy tridens, windmillgrass, tumblegrass, threeawn, yarrow, broomweed, ragweed, ironweed, thistle, persimmon, and other annual grasses and forbs come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Wetland range site

This range site consists of Tribbey soils in map unit 86. This tall-grass community is 50 percent grasses, 10 percent forbs, and 40 percent woody plants.

Switchgrass, indiangrass, big bluestem, little bluestem, prairie cordgrass, wildrye, and western wheatgrass are preferred by livestock. These plants make up 50 percent of the forage production when the site is in excellent condition. The preferred plants disappear first under continuous or heavy grazing to be replaced by desirable, but less palatable, plants such as beaked panicum, bushy bluestem, sedges, rushes, willow, smartweed, curly dock, barnyardgrass, and Florida paspalum.

Continued grazing and extreme climatic conditions cause the desirable plants to decrease. As the plant community deteriorates, undesirable plants such as cattails, buttonbush, seacoast sumpweed, tamarisk, cottonwood, green ash, annual bluegrass, sandbur, plains coreopsis, waterhemlock, and sixweeks fescue come to dominate the site. When undesirable plants are present, forage production is much less than when the site is in excellent condition, and woody plants increase.

Windbreaks and Environmental Plantings

Norman E. Smola, forester, Soil Conservation Service, helped to prepare this section.

Native trees and shrubs grow on only about 20,800 acres in Payne County. They grow primarily in the Cross Timbers major land resource area and along the Cimarron River and its tributaries. American elm, blackjack oak, black willow, cottonwood, green ash, hackberry, and red mulberry are the more common trees. Some of the more common introduced trees are black locust, chinaberry, osageorange, and saltcedar.

Most of the farmsteads in Payne County have trees around them that have been planted at various times. Several farmstead windbreaks and some field windbreaks have also been planted. Eastern redcedar, Austrian pine, arborvitae, Russian-olive, common hackberry, and mulberry are commonly in the windbreaks.

In order for windbreaks to fulfill their intended purpose, the trees and shrubs must match the soils. Matching the trees with the kind of soil is the first step towards insuring survival. It also helps to insure a maximum rate of growth. Soil depth and texture greatly affect the rate of growth of trees and shrubs in windbreaks.

Moisture is very limiting for tree survival in Payne County. Therefore, proper site preparation prior to planting and control of weeds or other competition after planting are major concerns in establishing and managing windbreaks. Supplemental watering significantly improves the survival and vigor of seedlings during the 3-year establishment period. Drip irrigation has been shown to be effective for windbreaks in Payne County.

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, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings 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.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and on 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

In table 8, the soils of the survey area are rated according to the 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 recreational 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 8, 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 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

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 gentle 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, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Billy M. Teels, biologist, Soil Conservation Service, helped to prepare this section.

Wildlife is fairly abundant throughout Payne County. Bobwhite quail, dove, rabbits, skunks, opossum, and coyote are found in all parts of the county. A few prairie chickens frequent the eastern part. Deer, beaver, bobcat, muskrat, and wild turkey are common along the bottom lands. Ducks are common on lakes and small ponds throughout the county late in fall and early in spring.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are wheat, oats, barley, grain sorghum, millet, cowpeas, and sunflower.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are plains bluestem, lovegrass, bermudagrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, indiangrass, switchgrass, goldenrod, beggarweed, wheatgrass, croton, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American plum, skunkbush sumac, chickasaw plum, and buckbrush.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, cattails, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, dove, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, bobwhite quail, jackrabbit, coyote, dove, meadowlark, and prairie dog.

Engineering

Charles E. Bollinger, assistant state engineer, and Timothy N. Miller, area civil engineer, helped to 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 a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must 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: evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 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 11 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 that 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 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 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 11 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 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with 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. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for 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.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 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 the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(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. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 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 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Dispersive clays are present in Payne County. They can cause problems with conservation engineering practices unless the material is specially treated. Dispersive clays are mainly in the subsoil and may go unnoticed unless exposed by gullies. Doolin, Huska, Oscar, and Seminole soils have dispersive clays because of their sodium content. Oil-waste land can also have the dispersive clay conditions. Where these soils are to remain exposed, treatment with lime can effectively stabilize them. Agricultural gypsum can be effective in waterways, terrace channels, and ridges. Designs for embankments made of soils that have dispersive clays may involve a combination of lime treatment and special placement location of the fill materials. Only about 3 percent of the soils in the county have, or are suspected of having, dispersive clays. Recognition and proper treatment of these soils is very important.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, 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 in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of 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. Losses are expressed in tons per acre per year. These 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 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed 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.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 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 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 high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in sloughs and potholes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 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 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severely corrosive environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 17 and the results of chemical analysis in table 18. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the Soil Morphology, Genesis, and Classification Laboratory, Department of Agronomy, Oklahoma State University, and the National Soil Survey Laboratory.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(7)*.

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).

Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (602), sodium (6P2), potassium (6Q2).

Cation-exchange capacity—sum of cations (5A3a).

Base saturation—sum of cations, TEA, pH 8.2 (5C3).

Reaction (pH)—1:1 water dilution (8C1a).

Organic matter—peroxide digestion (6A3).

Total phosphorus—perchloric acid; colorimetry (6S1a).

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Oklahoma Department of Transportation, Materials Division.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(8)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Arguistolls (*Argil*, referring to the argillic horizon, plus *ustoll*, the suborder of the Mollisols that have a ustic (dry) moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Udic Argiustolls (*Udic* identifying an intergrade to the Udolls).

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, thermic Udic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (6)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (8)*. Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Agra Series

Agra soils are deep, moderately well drained, and very slowly permeable. They are on broad, convex, very gently sloping to gently sloping ridgetops and side slopes on uplands in the eastern part of Payne County. These soils formed in material weathered from Pennsylvanian shales that contain thin layers of interbedded sandstone. They have a perched water table at a depth of 3 to 4 feet in winter and spring. The soils of the Agra series are fine, mixed, thermic, Udertic Paleustolls. Slope ranges from 1 to 5 percent.

Agra soils are commonly near Coyle, Huska, Mulhall, Norge, Seminole, and Steedman soils. Coyle and Mulhall soils have a fine-loamy control section. Huska soils have an ochric epipedon and a natric horizon. Norge soils have a fine-silty control section. Seminole soils have a natric horizon. Steedman soils have an ochric epipedon and have a solum less than 40 inches thick.

Typical pedon of Agra silt loam in an area of Agra silt loam, 1 to 3 percent slopes, in tame pasture about 2 miles north and 1 mile west of Yale, Oklahoma; 2,000 feet west and 1,050 feet south of the northeast corner of sec. 12, T. 19 N., R. 5 E.

Ap—0 to 7 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

A1—7 to 11 inches; dark brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B1—11 to 16 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; hard, firm; thin patchy clay films on peds; slightly acid; gradual smooth boundary.

B21t—16 to 30 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; nearly continuous dark brown (7.5YR 4/2) clay films on peds; neutral; gradual smooth boundary.

B22t—30 to 42 inches; light brown (7.5YR 6/4) silty clay, brown (7.5YR 5/4) moist; common fine distinct strong brown, brown, and light yellowish brown mottles; moderate medium and coarse subangular blocky structure; very hard, very firm; nearly continuous dark brown (7.5YR 4/2) clay films on peds; few fine black bodies; mildly alkaline; gradual smooth boundary.

B3—42 to 80 inches; coarsely mottled gray (N 6/0), pinkish gray (7.5YR 7/2), light brown (7.5YR 6/4), and reddish yellow (7.5YR 6/6) silty clay; weak coarse subangular blocky structure; very hard, very firm; patchy clay films on peds; few fine black bodies; few fine calcium carbonate concretions; moderately alkaline.

The solum is 60 to more than 80 inches thick. Depth to secondary carbonates is 40 to more than 60 inches. The A horizon is 6 to 14 inches thick. The mollic epipedon is less than 20 inches thick.

The Ap and A1 horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to mildly alkaline.

The B1 horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. Texture is silty clay loam or clay loam. Reaction ranges from medium acid to mildly alkaline. In some eroded areas the B1 horizon has been mixed into the Ap horizon by plowing.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. In some pedons it has mottles in shades of red or brown. Texture is silty clay, clay, silty clay loam, or clay loam. In some pedons this horizon has slickensides and calcium carbonate concretions. Reaction ranges from medium acid to moderately alkaline.

The B22t horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 6. In some pedons it has mottles in shades of brown or red. Texture is silty clay or clay. In some pedons this horizon has slickensides and calcium carbonate concretions. Reaction ranges from neutral to moderately alkaline.

The B3 horizon has hue of 7.5YR or 10YR, value of 4 or 6, and chroma of 3 to 6. It contains many coarse mottles in shades of red, yellow, brown, or gray. Texture is clay, silty clay, silty clay loam, or clay loam. In some pedons this horizon has gypsum crystals and slickensides. Reaction is mildly alkaline or moderately alkaline.

Asher Series

Asher soils are deep, moderately well drained, and slowly permeable. They are on narrow, nearly level, high flood plains along the Cimarron River. These soils formed in thick deposits of clayey and loamy, calcareous alluvial sediment. The soils of the Asher series are fine-silty, mixed, thermic Fluventic Haplustolls. Slope ranges from 0 to 1 percent.

Asher soils are commonly near Canadian, Dale, Goodnight, and Hawley soils. Canadian soils have a coarse-loamy control section. Dale soils have a mollic epipedon more than 20 inches thick. Goodnight soils have a sandy control section. Hawley soils have a coarse-loamy control section and have an ochric epipedon.

Typical pedon of Asher silty clay loam in an area of Asher silty clay loam, rarely flooded, in an alfalfa field about 1 mile south and 1 mile east of Perkins, Oklahoma; 1,100 feet west and 100 feet south of the northeast corner of sec. 17, T. 17 N., R. 3 E.

Ap—0 to 11 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; hard, firm; neutral; clear smooth boundary.

B2—11 to 22 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; very hard, very firm; neutral; clear smooth boundary.

IIC1—22 to 42 inches; reddish brown (5YR 5/4) stratified fine sandy loam and loam, reddish brown (5YR 4/4) moist; massive; hard, very friable; mildly alkaline; clear smooth boundary.

IIC2—42 to 80 inches; light reddish brown (5YR 6/4) stratified loam, fine sandy loam, very fine sandy loam, and silty clay loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The solum is 20 to 38 inches thick.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Reaction ranges from slightly acid to mildly alkaline.

The B2 horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. Texture is silty clay loam or clay loam; this horizon is 27 to 35 percent clay. Reaction is neutral or mildly alkaline.

The IIC1 horizon has hue of 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is loam or very fine sandy loam, or the horizon is stratified silt loam to fine sandy loam. Reaction ranges from neutral to moderately alkaline.

The IIC2 horizon has hue of 5YR, value of 4 to 6, and chroma of 4 to 6. It is stratified loamy fine sand to silty clay loam.

Ashport Series

Ashport soils are deep, well drained, and moderately permeable. They are on narrow, nearly level, low flood plains along large and small tributaries. These soils formed in thick to thin deposits of recent loamy alluvial sediments. The soils of the Ashport series are fine-silty, mixed, thermic Fluventic Haplustolls. Slope ranges from 0 to 1 percent.

Ashport soils are commonly near Easpur, Gowen, Oscar, Port, and Pulaski soils. Easpur soils have a fine-loamy control section. Gowen soils have a fine-loamy control section, and their mollic epipedon is more than 20 inches thick. Oscar soils have a natric horizon. Port soils have a mollic epipedon more than 20 inches thick. Pulaski soils have a coarse-loamy control section and have an ochric epipedon.

Typical pedon of Ashport silty clay loam in an area of Ashport silty clay loam, occasionally flooded, in cropland about 1/2 mile west of Stillwater, Oklahoma; 2,540 feet east and 920 feet north of the southwest corner of sec. 16, T. 19 N., R. 2 E.

Ap—0 to 5 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; weak medium platy structure; very hard, firm; many fine roots; slightly acid; abrupt smooth boundary.

A1—5 to 16 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; many fine roots; neutral; clear smooth boundary.

B2—16 to 36 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard, firm; few fine roots; slightly acid; clear smooth boundary.

Ab—36 to 52 inches; dark reddish gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; weak coarse prismatic structure parting to weak medium granular; slightly hard, friable; slightly acid; gradual smooth boundary.

B2b—52 to 66 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; slightly acid; gradual smooth boundary.

B3b—66 to 80 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable; neutral.

The solum is 26 to more than 60 inches thick. Depth to a buried horizon ranges from 24 to more than 60 inches. The A horizon is 10 to 16 inches thick. The mollic epipedon is less than 20 inches thick.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Texture is silt loam or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is silty clay loam, clay loam, loam, or silt loam. Reaction ranges from slightly acid to moderately alkaline. In some pedons this horizon is slightly effervescent below the 10- to 40-inch control section.

The Ab horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 to 4. Texture is loam, silt loam, clay loam, or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The B2b horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam, silt loam, or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The B3b horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4 to 6. Texture and reaction are the same as in the B2b horizon.

Some pedons have a C horizon below the B2 horizon. The C horizon has hue of 2.5YR or 5YR, value of 5, and chroma of 4 to 6. Texture is loam, silt loam, or clay loam that is stratified with coarser or finer materials. Reaction is mildly alkaline or moderately alkaline. Some pedons are slightly effervescent below the 10- to 40-inch control section.

Bethany Series

Bethany soils are deep, well drained, and slowly permeable. They are on broad, convex, nearly level to very gently sloping ridgetops on uplands. These soils formed in thick deposits of old, clayey alluvial sediments.

The soils of the Bethany series are fine, mixed, thermic Pachic Paleustolls. Slope ranges from 0 to 2.

Bethany soils are commonly near Kirkland, Norge, Navina, and Renfrow soils. Kirkland soils have an abrupt textural change between the A horizon and the B2t horizon. Norge soils have a fine-silty control section. Navina soils have a fine-loamy control section. Renfrow soils have a mollic epipedon that is less than 20 inches thick.

Typical pedon of Bethany silt loam in an area of Bethany silt loam, 0 to 2 percent slopes, in a hay meadow about 4 miles south of Stillwater, Oklahoma; 2,100 feet east and 1,500 feet north of the southwest corner of sec. 11, T. 18 N., R. 2 E.

A1—0 to 10 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; neutral; clear smooth boundary.

B1—10 to 14 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; strong medium subangular blocky structure; hard, firm; thin patchy clay films on peds; neutral; clear smooth boundary.

B21t—14 to 22 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium blocky structure; hard, firm; thin nearly continuous clay films on peds; moderately alkaline; gradual smooth boundary.

B22t—22 to 39 inches; brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) moist; moderate medium blocky structure; hard, firm; thin nearly continuous clay films on peds; moderately alkaline; gradual smooth boundary.

B3—39 to 65 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; weak coarse blocky structure; hard, firm; moderately alkaline; gradual smooth boundary.

Cr—65 to 80 inches; red (2.5YR 4/6) stratified shale and sandy shale.

The thickness of the solum is more than 60 inches and commonly is the same as depth to bedrock.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 2. Reaction is slightly acid or neutral.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3. Texture is silty clay loam, silty clay, or clay; this horizon is 35 to 42 percent clay. Reaction ranges from neutral to moderately alkaline.

The B22t horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Texture is silty clay loam, silty clay, or clay. Reaction is mildly alkaline or moderately alkaline.

The B23t horizon, where present, has hue of 5YR, value of 5 or 6, and chroma of 4 to 6. Texture is silty clay loam or clay. Reaction is moderately alkaline.

The B3 horizon has hue of 2.5YR to 7.5YR, value of 5, and chroma of 4 to 6. In some pedons it is mottled in shades of red or brown. Texture is silty clay loam or silty clay.

The Cr horizon, where present, typically is clay or sandy shale. It has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 6. In some pedons it is mottled in shades of red, brown, or gray.

Canadian Series

Canadian soils are deep, well drained, and moderately rapidly permeable. They are on broad, nearly level, high flood plains along the Cimarron River. These soils formed in thick deposits of recent loamy alluvial sediment. The soils of the Canadian series are coarse-loamy, mixed, thermic Udic Haplustolls. Slope ranges from 0 to 1 percent.

Canadian soils are commonly near Asher, Dale, Goodnight, and Hawley soils. Asher soils have a fine-silty control section. Dale soils have a fine-silty control section and have a mollic epipedon more than 20 inches thick. Goodnight soils have a sandy control section. Hawley soils have an ochric epipedon.

Typical pedon of Canadian fine sandy loam in an area of Canadian fine sandy loam, rarely flooded, in a grain sorghum field about 1/2 mile east and 1 1/2 miles south of Yale, Oklahoma; 400 feet north and 1,600 feet west of the southeast corner of sec. 25, T. 19 N., R. 5 E.

Ap—0 to 8 inches; brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

A1—8 to 22 inches; dark brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; gradual smooth boundary.

B2—22 to 48 inches; brown (7.5YR 5/3) fine sandy loam, brown (7.5YR 4/3) moist; weak fine and medium granular structure; slightly hard, very friable; neutral; gradual smooth boundary.

C—48 to 72 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; massive; bedding planes evident; slightly hard, very friable; neutral.

The solum is 40 to 60 inches thick.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to mildly alkaline.

The B2 horizon has hue of 5YR or 7.5YR, value of 4 to 7, and chroma of 2 to 6. In some pedons it is mottled in shades of red. Texture is fine sandy loam, loam, or sandy loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 3 to 6. Texture is fine sandy loam or loamy fine sand. Reaction ranges from neutral to moderately alkaline.

The Canadian soils in this county are taxadjuncts to the Canadian series because their mollic epipedon is slightly thicker than is typical for the Canadian series. Use, behavior, and management are similar to those of the Canadian series.

Chickasha Series

Chickasha soils are deep, well drained, and moderately permeable. They are on broad, convex, very gently sloping to sloping ridgetops and side slopes on uplands, mainly in the southeastern part of Payne County. These soils formed in material weathered from Permian sandstone. The soils of the Chickasha series are fine-loamy, mixed, thermic Udic Argiustolls. Slope ranges from 1 to 5 percent.

Chickasha soils are commonly near Coyle, Doolin, Seminole, and Zaneis soils. Coyle soils are underlain by sandstone bedrock at a depth of less than 40 inches. Doolin soils have more than 35 percent clay in the control section, have a natric horizon, and have an abrupt textural change between the A horizon and the B2t horizon. Seminole soils have more than 35 percent clay in the control section and have a natric horizon. Zaneis soils have hue of 5YR or redder in the B2t horizon.

Typical pedon of Chickasha loam in an area of Chickasha loam, 1 to 3 percent slopes, in rangeland about 6 miles east and 1-1/2 miles south of Cushing, Oklahoma; 1,500 feet south and 75 feet west of the northeast corner of sec. 11, T. 17 N., R. 6 E.

A1—0 to 12 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

B1—12 to 19 inches; dark yellowish brown (10YR 4/4) loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable; medium acid; clear smooth boundary.

B21t—19 to 28 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; few fine distinct strong brown mottles; moderate medium subangular blocky structure; hard, friable; thin patchy clay films on peds; medium acid; clear smooth boundary.

B22t—28 to 34 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; many coarse faint strong brown (7.5YR 5/8) and red (2.5YR 5/6) mottles; weak medium subangular blocky structure; hard, friable; thin patchy clay films on peds; medium acid; clear smooth boundary.

B3—34 to 44 inches; coarsely mottled red (2.5YR 4/8), brownish yellow (10YR 6/6), and strong brown (7.5YR 5/8) sandy clay loam; weak medium subangular blocky structure; hard, very friable; neutral; abrupt smooth boundary.

Cr—44 to 50 inches; yellowish brown (10YR 5/6) and red (2.5YR 5/6) sandstone; rippable when moist, hard when dry.

The thickness of the solum ranges from 40 to 60 inches and commonly is the same as depth to bedrock.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is fine sandy loam or loam. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is loam, sandy clay loam, or clay loam. Reaction ranges from medium acid to neutral.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. In some pedons it is mottled in shades of red or brown. Texture is loam, sandy clay loam, or clay loam. Reaction ranges from medium acid to neutral.

The B22t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. In some pedons it is mottled in shades of yellow, red, or brown. Texture is loam, sandy clay loam, or clay loam. Reaction ranges from medium acid to neutral.

The B3 horizon has hue of 2.5YR to 10YR, value of 4 to 7, and chroma of 4 to 8. In some pedons it is coarsely mottled or has mottles in shades of red, brown, yellow, or gray. Texture is loam or sandy clay loam. Reaction ranges from medium acid to moderately alkaline.

The Cr horizon is brownish, reddish, yellowish, or grayish paralithic sandstone that is rippable when moist and hard when dry.

The Chickasha soils in map units 7 and 77 are taxadjuncts to the Chickasha series because they have a mollic surface layer slightly thinner than is typical for the series. Use, behavior, and management are similar to those of the Chickasha series.

Coyle Series

Coyle soils are moderately deep, well drained, and moderately permeable. They are on narrow, convex, very gently sloping to gently sloping ridgetops and side slopes on uplands. These soils formed in material weathered from Permian sandstone. The soils of the Coyle series are fine-loamy, siliceous, thermic Udic Argiustolls. Slope ranges from 1 to 5 percent.

Coyle soils are commonly near Agra, Chickasha, Grainola, Huska, Lucien, Mulhall, Renfrow, Stephenville, and Zaneis soils. Agra soils have a fine control section. Chickasha soils have a solum more than 40 inches thick. Grainola soils have an ochric epipedon and have a fine control section. Huska soils have an ochric epipedon and have a natric horizon. Lucien soils have a solum less than 20 inches thick and do not have an argillic horizon. Mulhall soils have a solum more than 40 inches thick. Renfrow soils have a fine control section. Stephenville soils have an ochric epipedon. Zaneis soils have mixed mineralogy and have a solum more than 40 inches thick.

Typical pedon of Coyle loam (fig. 16) in an area of Coyle loam, 1 to 3 percent slopes, in rangeland about 6 miles south and 3 miles east of Stillwater, Oklahoma; 70 feet north and 460 feet west of the southeast corner of sec. 17, T. 18 N., R. 2 E.

A1—0 to 11 inches; dark reddish gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; strong fine granular structure; slightly hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

B1—11 to 14 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; slightly hard, friable; many fine roots; many fine pores; many wormcasts; mildly alkaline; clear smooth boundary.

B21t—14 to 31 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; thin nearly continuous clay films on peds; neutral; gradual smooth boundary.

B22t—31 to 39 inches; light red (2.5YR 6/8) sandy clay loam, red (2.5YR 5/8) moist; weak coarse subangular blocky structure; hard, firm; common fine roots; few coarse fragments of sandstone less than 76 mm in diameter; patchy clay films on peds; neutral; abrupt smooth boundary.

Cr—39 to 42 inches; red (2.5YR 5/6) sandstone; can be augered when moist.

The thickness of the solum ranges from 20 to 40 inches and is the same as the depth to sandstone bedrock.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is fine sandy loam or loam. Reaction ranges from medium acid to mildly alkaline.

The B1 horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 to 4. Texture is loam or fine sandy loam. Reaction ranges from medium acid to mildly alkaline.

The B21t horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6. In some pedons it has mottles in shades of red or brown. Texture is clay loam or sandy clay loam. Coarse fragments of sandstone less than 76 mm in diameter make up 0 to 10 percent by volume. Reaction ranges from medium acid to mildly alkaline.

The B22t horizon has hue of 2.5YR to 7.5YR, value of 5 or 6, and chroma of 4 to 8. In some pedons there are mottles in shades of yellow, red, or brown. Texture is clay loam, fine sandy loam, or sandy clay loam. This horizon is channery or flaggy in some pedons. Coarse fragments of sandstone make up 0 to 35 percent by volume; about 0 to 30 percent is less than 76 mm in diameter and 0 to 30 percent is more than 76 mm in diameter. Reaction ranges from medium acid to mildly alkaline.

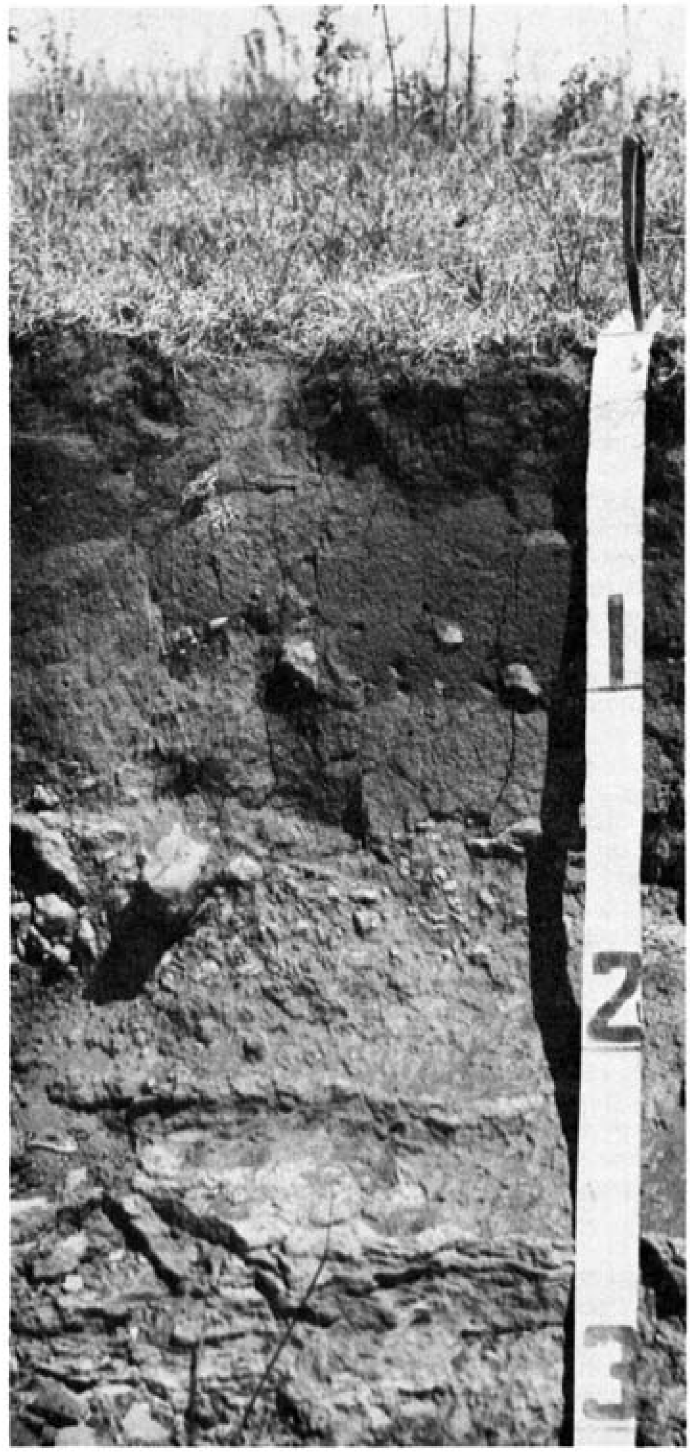


Figure 16.—Profile of Coyle loam.

Some pedons have a B23t horizon up to 10 inches thick. It is similar to the B22t horizon in color, texture, and reaction.

The sandstone Cr horizon is the same color as the B22t horizon and is rippable when moist.

The Coyle soil in map unit 76 is a taxadjunct to the Coyle series because it has a mollic surface layer slightly thinner than is typical for the series. Use, behavior, and management are similar to those of the Coyle series.

Dale Series

Dale soils are deep, well drained, and moderately permeable. They are on broad, nearly level, high flood plains along the Cimarron River and also on narrow, nearly level, high flood plains along major tributaries in the central and western parts of Payne County. These soils formed in thick deposits of loamy alluvial sediment. The soils of the Dale series are fine-silty, mixed, thermic Pachic Haplustolls. Slope ranges from 0 to 1 percent.

Dale soils are commonly near Asher, Canadian, Hawley, and McLain soils. Asher soils have a mollic epipedon that is less than 20 inches thick. Canadian soils have a coarse-loamy control section. Hawley soils have a coarse-loamy control section and have an ochric epipedon. McLain soils have a fine control section.

Typical pedon of Dale silt loam in an area of Dale silt loam, rarely flooded, in an alfalfa field about 1-1/2 miles north and 4 miles east of Ripley, Oklahoma; 400 feet north and 50 feet west of the southeast corner of sec. 11, T. 18 N., R. 4 E.

Ap—0 to 12 inches; dark reddish gray (5YR 4/2) silt loam, dark reddish brown (5YR 3/2) moist; weak fine granular structure; hard, friable; neutral; clear smooth boundary.

A1—12 to 26 inches; dark reddish gray (5YR 4/2) silt loam, dark reddish brown (5YR 3/2) moist; moderate medium granular structure; hard, friable; neutral; gradual smooth boundary.

B21—26 to 38 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, friable; mildly alkaline; gradual smooth boundary.

B22—38 to 48 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, friable; mildly alkaline; gradual smooth boundary.

C1—48 to 58 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; massive; hard, friable; mildly alkaline; gradual smooth boundary.

C2—58 to 78 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; mildly alkaline.

The solum is more than 30 inches thick. The mollic epipedon is 20 to 36 inches thick.

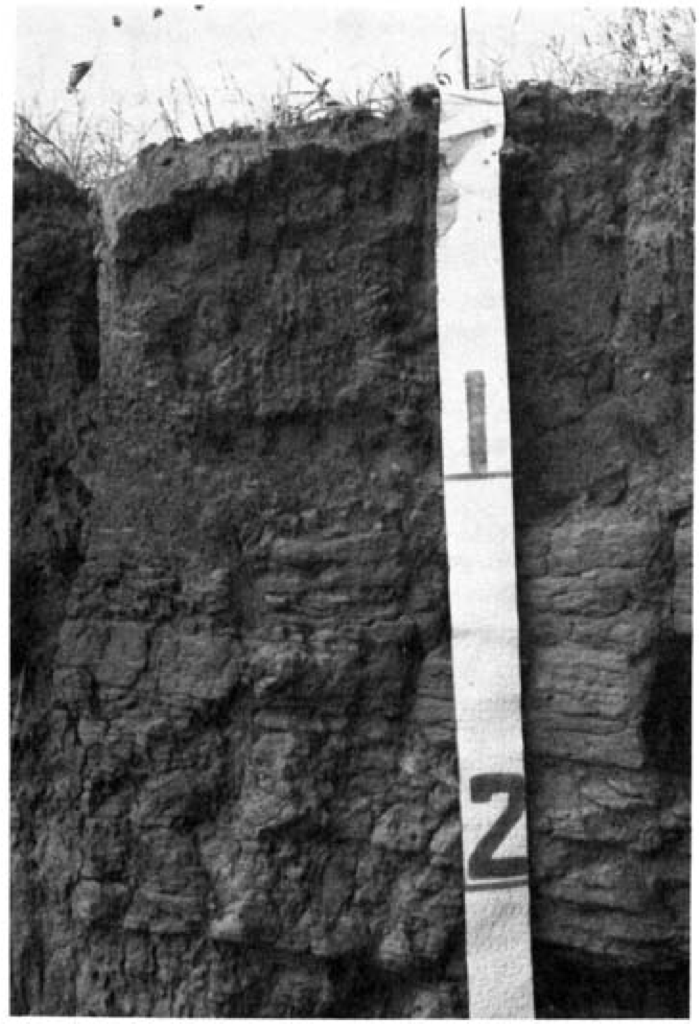


Figure 17.—Profile of Darnell fine sandy loam.

The A horizon has hue of 5YR to 10YR, value of 4, and chroma of 2 or 3. Reaction ranges from slightly acid to mildly alkaline.

The B2 horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 3 or 4. Texture is loam, silt loam, or clay loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon has hue of 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is loam, fine sandy loam, or sandy clay loam. Reaction is mildly alkaline or moderately alkaline.

The Dale soils in this county are taxadjuncts to the Dale series because they do not have soft, powdery lime within a depth of 60 inches. Use, behavior, and management are similar to those of the Dale series.

Darnell Series

The soils of the Darnell series are shallow, well drained and somewhat excessively drained, and moderately rapidly permeable. They are on broad, convex, very gently sloping to steep ridgetops and side slopes on uplands. These soils formed in material weathered from Permian sandstone. The soils of the Darnell series are loamy, siliceous, thermic, shallow Udic Ustochrepts. Slope ranges from 1 to 45 percent.

Darnell soils are commonly near Harrah, Lucien, and Stephenville soils. Harrah soils have an argillic horizon, and their solum is more than 60 inches thick. Lucien soils have a mollic epipedon. Stephenville soils have an argillic horizon, and their solum is more than 20 inches thick.

Typical pedon of Darnell fine sandy loam (fig. 17) in an area of Stephenville-Darnell complex, 1 to 8 percent slopes, in rangeland about 6 miles west and 1 mile south of Stillwater, Oklahoma; 1,800 feet south and 150 feet west of the northeast corner of sec. 28, T. 19 N., R. 1 E.

A1—0 to 5 inches; dark brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable; neutral; clear smooth boundary.

B2—5 to 18 inches, light brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; neutral; clear irregular boundary.

Cr—18 to 22 inches; reddish yellow (7.5YR 6/6) soft sandstone.

The thickness of the solum ranges from 10 to 20 inches and is the same as depth to bedrock.

The A horizon typically has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Reaction ranges from medium acid to neutral.

The B2 horizon has hue of 2.5YR to 10YR, value of 4 to 7, and chroma of 3 to 6. Texture is fine sandy loam or loam. Reaction ranges from strongly acid to neutral.

The Cr horizon is reddish, yellowish, or brownish sandstone.

Derby Series

Derby soils are deep, somewhat excessively drained, and rapidly permeable. They are on broad, convex, undulating to rolling uplands. These soils formed in deposits of wind-reworked sandy alluvial sediment. The soils of the Derby series are mixed, thermic Alfic Ustipsamments. Slope ranges from 1 to 35 percent.

Derby soils are commonly near Eufaula, Goodnight, and Slaughterville soils. Eufaula soils have lamellae, each thicker than 1 centimeter, totaling 15 centimeters or more in thickness within 2.5 meters of the surface. Goodnight soils do not have lamellae. Slaughterville soils have a coarse-loamy control section.

Typical pedon of Derby fine sandy loam in an area of Derby fine sandy loam, 15 to 35 percent slopes, in rangeland about 3 miles west and 3 miles south of Yale, Oklahoma; 2,200 feet south and 200 feet west of the northeast corner of sec. 3, T. 18 N., R. 5 E.

A11—0 to 9 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A12—9 to 20 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; single grained; loose; medium acid; clear smooth boundary.

A21—20 to 54 inches; pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; slightly acid; diffuse smooth boundary.

A22&B21t—54 to 72 inches; reddish yellow (7.5YR 6/6) fine sand, strong brown (7.5YR 5/6) moist (A22); single grained; loose; neutral, lamellae of yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist (B21t); lamellae are 2 to 15 cm apart and 2 to 10 mm thick and are discontinuous horizontally; massive; soft, very friable; slightly acid; diffuse smooth boundary.

A23&B22t—72 to 120 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist (A23); single grained; loose; neutral; lamellae of yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist (B22t); lamellae are 5 to 15 cm apart and 2 to 12 mm thick, and continuous horizontally; massive; soft, very friable; neutral.

The solum is more than 60 inches thick. Depth to the uppermost lamallae is 44 to 60 inches. The A horizon is less than 20 inches thick where the texture is loamy fine sand.

The Ap or A11 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is fine sandy loam or loamy fine sand. Reaction ranges from medium acid to mildly alkaline.

The A12 horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4. Texture is fine sand or loamy fine sand. Reaction ranges from medium acid to mildly alkaline.

The A21 horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 4 to 6. Texture is fine sand or loamy fine sand. Reaction ranges from slightly acid to mildly alkaline.

The A22 and A23 parts of the A22&B21t and A23&B22t horizons have hue of 5YR to 10YR, value of 6 to 8, and chroma of 4 to 8. Texture is loamy fine sand or fine sand. Reaction ranges from slightly acid to moderately alkaline.

The B21t and B22t parts of the A22&B21t and A23&B22t horizons have hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. These lamellae range from thin bands in the B21t part to thick bands in the B22t part and become thin again with depth. Thickness of the lamellae range from 1 to 25 mm, but those more than 1 cm thick do not reach a cumulative total of 15 cm within a depth of 60 inches in any pedon. These lamellae are usually 2 to 20 cm apart. Texture is mainly loamy fine sand, but fine sand and fine sandy loam occur in some pedons. Reaction ranges from slightly acid to moderately alkaline.

Some pedons have a C horizon. Where present, the C horizon has hue of 7.5YR, value of 6 or 7, and chroma of 6 to 8. Bedding planes of eolian origin are evident, and cross bedding is common.

In some pedons, the C horizon is not present and the zone of lamellae rests on older buried terrace sediment. This older sediment is more red and is loamy and consists of thicker lamellae or continuous subsoil material.

Doolin Series

Doolin soils are deep, moderately well drained, and very slowly permeable. They are on broad, slightly concave, nearly level to very gently sloping ridgetops on uplands in the central part of Payne County. These soils formed in sediment weathered from old alluvium and the underlying Permian sandstone. The soils of the Doolin series are fine, montmorillonitic, thermic Typic Natrustolls. Slope ranges from 0 to 2 percent.

Doolin soils are commonly near Chickasha, Huska, Kirkland, Renfrow, and Zaneis soils. Chickasha soils have a fine-loamy control section. Huska soils have an ochric epipedon and a solum less than 60 inches thick. Kirkland and Renfrow soils do not have a natric horizon. Zaneis soils have a fine-loamy control section.

Typical pedon of Doolin silt loam in an area of Doolin silt loam, 0 to 2 percent slopes, in rangeland about 10 miles east and 3 miles north of Stillwater, Oklahoma; 1,100 feet west and 50 feet south of the northeast corner of sec. 2, T. 19 N., R. 4 E.

A1—0 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B21t—12 to 20 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; common fine distinct reddish brown mottles; strong coarse columnar structure parting to moderate medium blocky; hard, firm; thick nearly continuous clay films on peds; few fine dark brown concretions; organic matter stains on peds; 16 percent exchangeable sodium; neutral; clear smooth boundary.

B22t—20 to 32 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; few fine distinct strong brown mottles; moderate medium blocky structure; hard, firm; thin nearly continuous clay films on peds; organic matter stains between peds; 15 percent exchangeable sodium; mildly alkaline; gradual smooth boundary.

IIB23t—32 to 48 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; many medium prominent strong brown (7.5YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure; hard, firm; thin patchy clay films on peds; many threads of salts; 18 percent exchangeable sodium; few medium and fine calcium carbonate concretions; mildly alkaline; gradual smooth boundary.

IIB24t—48 to 68 inches; reddish yellow (7.5YR 6/8) clay loam, strong brown (7.5YR 5/8) moist; many coarse prominent gray (10YR 5/1), light gray (10YR 7/2), and red (2.5YR 4/8) mottles; weak coarse prismatic structure; hard, firm; thin patchy clay films on peds; 18 percent exchangeable sodium; mildly alkaline; abrupt smooth boundary.

IICr—68 to 70 inches; strong brown (7.5YR 5/6) sandstone.

Solum thickness is more than 60 inches and commonly is the same as the depth to bedrock. Depth to secondary carbonates is more than 30 inches. Exchangeable sodium ranges from 15 to 20 percent in the B21t, B22t, IIB23t, and IIB24t horizons. Electrical conductivity of the saturation extract ranges from 0 to 2 millimhos per centimeter in the A, B21t, and B22t horizons and from 2 to 6 millimhos per centimeter in the IIB23t and IIB24t horizons.

The Ap or A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2. Reaction ranges from medium acid to mildly alkaline.

The B21t horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 2 to 4. In some pedons the ped faces have lower value and chroma than the matrix. Texture is silty clay loam, silty clay, or clay. Rounded dark concretions make up 0 to 5 percent by volume. Reaction ranges from slightly acid to moderately alkaline.

The B22t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4 with mottles in shades of brown. Texture is silty clay loam, clay, silty clay, or clay loam. Reaction is mildly alkaline or moderately alkaline.

The IIB23t and IIB24t horizons have hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 8. Mottles in shades of red, brown, and gray are in the lower part. Texture is clay loam or sandy clay loam. Calcium carbonate concretions are present in the upper part in most pedons. Threads of salts are present in most pedons. Reaction is mildly alkaline or moderately alkaline.

The IICr horizon is red or brown sandstone.

Dougherty Series

Dougherty soils are deep, well drained, and moderately permeable. They are on broad, convex, nearly level to strongly sloping ridgetops and side slopes on uplands. These soils formed in thick deposits of wind-reworked old loamy alluvial sediment. The soils of the Dougherty series are loamy, mixed, thermic Arenic Haplustalfs. Slope ranges from 0 to 12 percent.

Dougherty soils are commonly near Eufaula, Konawa, Slaughterville, and Teller soils. Eufaula soils have a sandy control section. Konawa soils have an A horizon less than 20 inches thick. Slaughterville soils have a coarse-loamy control section and do not have an argillic horizon. Teller soils have a mollic epipedon.

Typical pedon of Dougherty loamy fine sand in an area of Dougherty loamy fine sand, 3 to 8 percent slopes, in a cultivated field about 9 miles south and 8 miles west of Stillwater, Oklahoma, on State Highway 33; 2,375 feet west and 50 feet south of the northeast corner of sec. 3, T. 17 N., R. 1 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

A2—6 to 26 inches; very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; massive; soft, very friable; medium acid; clear smooth boundary.

B2t—26 to 42 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; clay films on peds and bridging sand grains; medium acid; diffuse smooth boundary.

B3—42 to 54 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, friable; medium acid; diffuse smooth boundary.

C—54 to 70 inches; yellowish red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/8) moist; massive; slightly hard, friable; medium acid.

The solum is 45 inches to more than 72 inches thick. The A horizon is 20 to 40 inches thick.

The Ap or A1 horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. Reaction ranges from strongly acid to slightly acid, except where the soil has been limed.

The A2 horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. Texture is loamy fine sand or fine sand. Reaction ranges from strongly acid to slightly acid, except where the soil has been limed.

The B2t horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 6 to 8. Texture is fine sandy loam or sandy clay loam. Reaction ranges from strongly acid to slightly acid.

The B3 horizon has the same color and reaction as the B2t horizon. Texture is fine sandy loam, sandy clay loam, or loamy fine sand.

The C horizon has the same color and reaction as the B2t horizon. Texture is fine sandy loam or loamy fine sand.

Easpur Series

Easpur soils are deep, well drained, and moderately permeable. They are on narrow, nearly level, low flood plains along major streams. These soils formed in thick deposits of recent loamy alluvial sediment. The soils of the Easpur series are fine-loamy, mixed, thermic Fluventic Haplustolls. Slope ranges from 0 to 1 percent.

Easpur soils are commonly near Ashport, Oscar, Port, and Pulaski soils. Ashport soils have a fine-silty control section. Oscar soils have a natric horizon. Port soils have a fine-silty control section and have a mollic epipedon more than 20 inches thick. Pulaski soils have a coarse-loamy control section and have an ochric epipedon.

Typical pedon of Easpur loam in an area of Easpur loam, occasionally flooded, in a cultivated field about 1/2 mile west of Stillwater, Oklahoma; 2,000 feet east and 1,300 feet north of the southwest corner of sec. 16, T. 19 N., R. 2 E.

Ap—0 to 11 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

B21—11 to 19 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable; many fine roots; neutral; clear smooth boundary.

B22—19 to 29 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; hard, firm; few fine roots; neutral; clear smooth boundary.

C—29 to 41 inches; stratified reddish brown (5YR 5/4) loam, yellowish red (5YR 5/6) fine sandy loam, and reddish brown (5YR 4/3) clay loam; strata are 1 to 4 inches thick; massive; slightly hard, friable; few fine roots; mildly alkaline; clear smooth boundary.

IIAb—41 to 62 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; hard, firm; mildly alkaline; clear smooth boundary.

IIB2b—62 to 72 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, firm; mildly alkaline.

Solum thickness ranges from 30 inches to more than 60 inches and commonly is the same as depth to buried horizons. Secondary carbonates are present in some pedons below a depth of 50 inches.

The Ap or A1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to moderately alkaline.

The B2 horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. Texture is loam, clay loam, fine sandy loam, or very fine sandy loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon has hue of 5YR, value of 4 to 7, and chroma of 3 to 6. It is stratified thin layers of fine sandy loam to clay loam. Reaction ranges from slightly acid to moderately alkaline.

The IIAb horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Texture is silt loam, silty clay loam, or loam. Reaction ranges from slightly acid to moderately alkaline.

The IIB2b horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is silt loam, silty clay loam, or loam. Reaction ranges from slightly acid to moderately alkaline.

Eufaula Series

Eufaula soils are deep, somewhat excessively drained, and rapidly permeable. They are on broad, convex, gently sloping to strongly sloping, hummocky ridgetops and side slopes on uplands. These soils formed in thick deposits of wind-reworked sandy and loamy alluvial sediment. The soils of the Eufaula series are sandy, siliceous, thermic Psammentic Paleustalfs. Slope ranges from 3 to 12 percent.

Eufaula soils are commonly near Derby, Dougherty, Konawa, and Teller soils. Derby soils do not have 1-centimeter-thick lamellae that total 15 centimeters or more in thickness within 2.5 meters of the surface. Dougherty soils have a loamy control section. Konawa soils have a fine-loamy control section and an A horizon less than 20 inches thick. Teller soils have a mollic epipedon.

Typical pedon of Eufaula loamy fine sand in an area of Eufaula-Dougherty complex, 3 to 12 percent slopes, in rangeland about 9 miles west of Perkins, Oklahoma; 600 feet west and 600 feet north of the southeast corner of sec. 4, T. 17 N., R. 1 E.

A1—0 to 11 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; weak very fine granular structure; loose; slightly acid; clear smooth boundary.

A21—11 to 48 inches; pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; slightly acid; clear smooth boundary.

A22&B2t—48 to 72 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 4/6) moist (A22); single grained; loose; slightly acid; lamellae of light reddish brown (5YR 6/4) loamy fine sand, reddish brown (5YR 5/4) moist (B2t); lamellae are 1/8 to 1 inch in thickness and 2 to 10 inches apart; massive; soft, very friable; lamellae have clay bridges between sand grains; slightly acid.

The solum is more than 72 inches thick.

The A1 horizon typically has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. Reaction ranges from strongly acid to neutral.

The A21 horizon has hue of 5YR to 10YR, value of 6 to 8, and chroma of 3 or 4. Texture is fine sand or loamy fine sand. Reaction ranges from strongly acid to neutral.

The A22 part of the A22&B2t horizon has hue of 5YR or 7.5YR, value of 6 or 7, and chroma of 4 to 6. Texture is fine sand or loamy fine sand. Reaction ranges from medium acid to neutral.

The B2t part of the A22&B2t horizon typically is 1/8 inch to 6 inches thick. The B2t part has hue of 2.5YR or 5YR, value of 4 to 7, and chroma of 4 to 8. Texture is fine sandy loam or loamy fine sand. Reaction ranges from strongly acid to neutral.

Gaddy Series

Gaddy soils are deep and somewhat excessively drained. Permeability is moderately rapid to rapid. They are on narrow, nearly level, low flood plains along the Cimarron River. These soils formed in thick deposits of recent sandy alluvial sediment. The soils of the Gaddy series are sandy, mixed, thermic Typic Ustifluvents. Slope ranges from 0 to 1 percent.

Gaddy soils are commonly near Goodnight, Gracemore, Harjo Variant, and Yahola soils. Goodnight soils do not have thin strata of finer texture in the control section. Gracemore soils have a water table within 40 inches of the surface most of the year. Harjo Variant soils have a clayey over sandy or sandy-skeletal control section. Yahola soils have a coarse-loamy control section.

Typical pedon of Gaddy loamy fine sand in an area of Gaddy loamy fine sand, occasionally flooded, in bermudagrass pasture about 1 mile east and 6 miles south of Yale, Oklahoma; 2,900 feet south and 1,600 feet west of the northeast corner of sec. 21, T. 18 N., R. 6 E.

A11—0 to 3 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained; loose; mildly alkaline; clear smooth boundary.

A12—3 to 13 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; weak very fine granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1—13 to 25 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; massive; loose; calcareous; moderately alkaline; gradual smooth boundary.

C2—25 to 80 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; massive; hard, very friable; few thin strata of brown (10YR 5/3) fine sandy loam; calcareous; moderately alkaline.

These soils are moderately alkaline and calcareous throughout the 10- to 40-inch control section. In some pedons the upper 10 inches is noncalcareous and mildly alkaline.

The A horizon typically has hue of 5YR to 10YR, value of 4 to 8, and chroma of 3 to 6. Texture of the upper 10 inches is loamy fine sand, fine sandy loam, or very fine sandy loam. Texture below a depth of 10 inches is loamy fine sand.

The C horizon has hue of 5YR to 10YR, value of 4 to 8, and chroma of 3 to 6. Texture is fine sand or loamy fine sand with thin strata of fine sandy loam to clay loam. The thin strata are darker in color and contain more organic matter than the matrix.

Goodnight Series

Goodnight soils are deep, excessively drained, and rapidly permeable. They are on narrow, convex, gently undulating to steep dunes on flood plains along the Cimarron River. These soils formed in thick deposits of wind-reworked recent sandy alluvial sediment. The soils of the Goodnight series are mixed, thermic Typic Ustipsamments. Slope ranges from 1 to 20 percent.

Goodnight soils are commonly near Asher, Canadian, Derby, Gaddy, Harjo Variant, Hawley, and Yahola soils. Asher and Canadian soils have a mollic epipedon. Derby soils have lamellae. Gaddy soils are calcareous throughout the control section and have strata of finer texture within the control section. Harjo Variant soils have a clayey over sandy or sandy-skeletal control section. Hawley soils have a coarse-loamy control section. Yahola soils have a coarse-loamy control section and are calcareous throughout the control section.

Typical pedon of Goodnight loamy fine sand in an area of Goodnight loamy fine sand, 5 to 20 percent slopes, in pastureland about 5 miles north and 1 mile east of Cushing, Oklahoma; 600 feet south and 200 feet east of the northwest corner of sec. 11, T. 18 N., R. 5 E.

A1—0 to 5 inches; brown (7.5YR 5/3) loamy fine sand, brown (7.5YR 4/3) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC1—5 to 16 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; slightly acid; gradual wavy boundary.

AC2—16 to 40 inches; reddish yellow (7.5YR 7/6) fine sand, reddish yellow (7.5YR 6/6) moist; single grained; loose; neutral; clear smooth boundary.

C—40 to 80 inches; reddish yellow (7.5YR 7/6) fine sand, reddish yellow (7.5YR 6/6) moist; single grained; loose; bedding planes and some cross-bedding; calcareous; moderately alkaline.

The solum is 10 to 60 inches thick. Depth to bedrock is more than 80 inches. The solum is noncalcareous. Texture is loamy fine sand or fine sand in all horizons.

The A1 or Ap horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. Reaction ranges from slightly acid to moderately alkaline.

The AC1 horizon has hue of 5YR or 7.5YR, value of 5 to 7, and chroma of 3 to 6. Reaction ranges from slightly acid to moderately alkaline.

The AC2 horizon has hue of 5YR or 7.5YR, value of 5 to 8, and chroma of 4 to 8. Reaction ranges from neutral to moderately alkaline.

The C horizon is similar in color to the AC2 horizon. Bedding planes of eolian origin are evident and cross-bedding is common. Some pedons have sandy alluvial sediment with loamy strata below a depth of 60 inches.

Gowen Series

Gowen soils are deep, well drained, and moderately permeable. They are on narrow, nearly level, low flood plains along minor tributaries in the eastern part of Payne County. These soils formed in thin deposits of loamy local alluvial sediment. The soils of the Gowen series are fine-loamy, mixed, thermic Cumulic Haplustolls. Slope ranges from 0 to 1 percent.

Gowen soils are commonly near Ashport soils. Ashport soils have a fine-silty control section and have a mollic epipedon less than 20 inches thick.

Typical pedon of Gowen loam in an area of Steedman-Gowen complex, 0 to 8 percent slopes; 200 feet south and 100 feet west of the northeast corner of sec. 13, T. 19 N., R. 5 E.

A11—0 to 25 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

A12—25 to 60 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; gradual smooth boundary.

B2—60 to 72 inches; brown (10YR 5/3) silt loam; dark brown (10YR 3/3) moist; weak coarse prismatic structure; slightly hard, friable; mildly alkaline.

The solum is more than 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction is neutral or mildly alkaline.

The B2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam, clay loam, or silt loam. Reaction is neutral or mildly alkaline.

The C horizon, where present, typically has hue of 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is stratified loam or silt loam. Reaction is neutral or mildly alkaline.

Gracemore Series

Gracemore soils are deep and somewhat poorly drained. Permeability is moderately rapid to rapid. They are on low, broad to narrow, nearly level flood plains along the Cimarron River. These soils formed in thick deposits of recent sandy alluvial sediment and have an apparent water table within 40 inches of the surface during most of the year. The soils of the Gracemore series are sandy, mixed, thermic Aquic Udifluvents. Slope ranges from 0 to 1 percent.

Gracemore soils are commonly near Gaddy, Harjo Variant, and Yahola soils. Gaddy soils do not have a water table within 40 inches of the surface most of the year. Harjo Variant soils have a clayey over sandy or sandy-skeletal control section. Yahola soils have a coarse-loamy control section.

Typical pedon of Gracemore fine sandy loam in an area of Gaddy-Gracemore complex, frequently flooded, in native pasture about 4 miles east and 1 mile south of Perkins, Oklahoma; 1,000 feet south and 2,200 feet west of the northeast corner of sec. 10, T. 17 N., R. 3 E.

A—0 to 4 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; loose; calcareous; moderately alkaline; clear smooth boundary.

C1—4 to 26 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; massive; loose; calcareous; moderately alkaline; clear smooth boundary.

C2—26 to 34 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; loose; few thin strata of pale brown (10YR 6/3) fine sand; calcareous; moderately alkaline; clear smooth boundary.

C3—34 to 72 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; massive; loose; common thin strata of dark brown (7.5YR 4/4) fine sandy loam; calcareous; moderately alkaline.

Depth to secondary carbonates ranges from 0 to 10 inches. Reaction is mildly alkaline to moderately alkaline in the upper 10 inches of the soil and moderately alkaline and calcareous below 10 inches.

The A horizon has hue of 5YR or 7.5YR, value of 5 to 8, and chroma of 4 to 6. Texture is fine sand, loamy fine sand, or fine sandy loam. Electrical conductivity of the saturation extract ranges from 4 to 16 millimhos per centimeter.

The C horizon typically has hue of 5YR to 10YR, value of 5 to 7, and chroma of 3 to 6. Texture is loamy fine sand or fine sand stratified with fine sandy loam. The electrical conductivity of saturation extract ranges from 4 to 16 millimhos per centimeter.

Grainola Series

Grainola soils are moderately deep, well drained, and slowly permeable. They are on broad, convex, gently sloping to strongly sloping ridgetops and side slopes on uplands. These soils formed in material weathered from Permian shales. The soils of the Grainola series are fine, mixed, thermic Vertic Haplustalfs. Slope ranges from 3 to 12 percent.

Grainola soils are commonly near Coyle, Huska, Lucien, Masham, Mulhall, Renfrow, and Shidler soils. Coyle and Mulhall soils have a mollic epipedon, siliceous mineralogy, and a fine-loamy control section. Huska soils have a natric horizon. Lucien soils are less than 20 inches thick and have a loamy control section. Masham soils are less than 20 inches thick. Renfrow soils are more than 60 inches thick and have a mollic epipedon. Shidler soils are less than 20 inches thick, have a mollic epipedon, and have a loamy control section.

Typical pedon of Grainola clay loam (fig. 18) in an area of Grainola clay loam, 3 to 5 percent slopes, in native pasture about 3 miles west of Cushing, Oklahoma; 1,700 feet east and 800 feet south of the northwest corner of sec. 1, T. 17 N., R. 4 E.

Ap—0 to 6 inches; dark reddish gray (5YR 4/2) clay loam, dark reddish brown (5YR 3/2) moist; weak fine subangular blocky structure; very hard, firm; neutral; clear smooth boundary.

B1—6 to 9 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; very hard, very firm; moderately alkaline; clear smooth boundary.

B21t—9 to 19 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium and fine subangular blocky structure; very hard, very firm; thin patchy clay films on peds; calcareous; moderately alkaline; clear smooth boundary.

B22t—19 to 35 inches; red (2.5YR 5/6) silty clay, red (2.5YR 4/6) moist; weak coarse subangular blocky structure; very hard, very firm; patchy clay films on peds; calcareous; moderately alkaline; gradual smooth boundary.

Cr—35 to 48 inches; red (2.5YR 4/6) shale.

The thickness of the solum ranges from 20 to 40 inches and commonly is the same as depth to bedrock. Depth to secondary carbonates ranges from 0 to 19 inches.

The A horizon has hue of 5YR, value of 4 or 5, and chroma of 2 to 4. Texture is loam, silt loam, bouldery clay loam, stony clay loam, silty clay loam, or clay loam. Coarse fragments of sandstone or limestone more than 3 inches in diameter make up 0 to 35 percent by volume. Reaction ranges from neutral to moderately alkaline.

The B1 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. Texture is clay loam, silty

Figure 18.—Profile of Grainola clay loam.

clay loam, silty clay, or clay. Reaction is mildly alkaline or moderately alkaline.

The B21t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is clay loam, silty clay loam, silty clay, or clay.

The B22t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is clay, silty clay, or silty clay loam.

The Cr horizon is reddish shale.

Harjo Variant

Harjo Variant soils are deep, somewhat poorly drained, and very slowly permeable. They are on low, depressional flood plains along the Cimarron River. A water table is within 40 inches of the surface during most of the year. These soils formed in thin deposits of recent clayey alluvial sediment. The soils of the Harjo Variant are clayey over sandy or sandy-skeletal, mixed (calcareous), thermic Aquic Udifluvents. Slope ranges from 0 to 1 percent.

Harjo Variant soils are commonly near Gaddy, Goodnight, Gracemore, and Yahola soils. Gaddy soils have a sandy control section and do not have a high water table. Goodnight soils have a sandy control section, do not have a high water table, and are not stratified. Gracemore soils have a sandy control section. Yahola soils have a coarse-loamy control section and do not have a high water table.

Typical pedon of Harjo Variant clay in an area of Harjo Variant clay, ponded, in cropland about 11 miles west of Perkins, Oklahoma; 1,700 feet north and 1,250 feet east of the southwest corner of sec. 6, T. 17 N., R. 1 E.

Ap—0 to 8 inches; reddish brown (5YR 5/3) clay, dark reddish brown (5YR 3/3) moist; weak fine granular structure; very hard, very firm; mildly alkaline; clear smooth boundary.

B2—8 to 30 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; weak coarse subangular blocky structure; very hard, very firm; few films of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

C1—30 to 60 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; thin strata of reddish yellow (7.5YR 7/6) loamy fine sand, reddish yellow (7.5YR 6/6) moist; calcareous; moderately alkaline; clear smooth boundary.

C2—60 to 72 inches; pink (7.5YR 8/4) fine sand, pink (7.5YR 7/4) moist; single grained; loose; thin strata of reddish yellow (7.5YR 7/6) loamy fine sand, reddish yellow (7.5YR 6/6) moist; calcareous; moderately alkaline.

Depth to secondary carbonates ranges from 0 to 11 inches.

The A horizon typically has hue of 5YR, value of 4 or 5, and chroma of 2 to 4. Reaction ranges from neutral to moderately alkaline.

The B2 horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. Texture is clay, silty clay, or clay loam.

The C1 horizon has hue of 5YR or 7.5YR, value of 4 to 7, and chroma of 4 to 6. In some pedons it is mottled in shades of gray. This horizon is stratified loamy fine sand and fine sand.

Harrah Series

Harrah soils are deep, well drained, and moderately permeable. They are on narrow, smooth, gently sloping to strongly sloping side slopes on uplands in the central and western parts of Payne County. These soils formed in colluvial material weathered from Permian sandstone. The soils of the Harrah series are fine-loamy, siliceous, thermic Ultic Paleustalfs. Slope ranges from 3 to 8 percent.

Harrah soils are commonly near Darnell, Mulhall, and Stephenville soils and are higher than Pulaski soils. Darnell soils are less than 20 inches deep and do not have an argillic horizon. Mulhall soils have a mollic epipedon. Pulaski soils are on flood plains, do not have an argillic horizon, have a coarse-loamy control section, and are stratified. Stephenville soils are less than 40 inches deep.

Typical pedon of Harrah fine sandy loam in an area of Harrah-Pulaski complex, 0 to 8 percent slopes, in rangeland about 4 miles west of Stillwater, Oklahoma; 800 feet west and 2,300 feet north of the southeast corner of sec. 12, T. 18 N., R. 1 E.

A1—0 to 4 inches; dark reddish gray (5YR 4/2) fine sandy loam, dark reddish brown (5YR 3/2) moist; weak fine granular structure; loose, very friable; neutral; clear wavy boundary.

A2—4 to 7 inches; reddish brown (2.5YR 5/4) fine sandy loam, reddish brown (2.5YR 4/4) moist; weak fine granular structure; loose, very friable; neutral; clear wavy boundary.

B21t—7 to 30 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; moderate medium prismatic structure; hard, friable; thin nearly continuous clay films on peds; very strongly acid; gradual wavy boundary.

B22t—30 to 64 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; weak coarse prismatic structure; hard, friable; thin patchy clay films on peds; strongly acid; gradual wavy boundary.

B23t—64 to 80 inches; red (2.5YR 5/8) sandy clay loam, red (2.5YR 4/8) moist; weak coarse prismatic structure; hard, friable; thin patchy clay films on peds; medium acid.

The solum is more than 60 inches thick. The A horizon is less than 20 inches thick.

The A1 horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Reaction ranges from very strongly acid to neutral.

The A2 horizon has hue of 2.5YR or 5YR, value of 5, and chroma of 4 to 6. Reaction ranges from very strongly acid to neutral.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 6 to 8. Texture is fine sandy loam or sandy clay loam. Reaction ranges from very strongly acid to slightly acid in the upper part and from very strongly acid to neutral in the lower part.

Hawley Series

Hawley soils are deep, well drained, and moderately permeable. They are on broad, undulating, high flood plains along the Cimarron River. These soils formed in thick deposits of loamy alluvial sediment. The soils of the Hawley series are coarse-loamy, mixed, thermic Fluventic Ustochrepts. Slope ranges from 1 to 3 percent.

Hawley soils are commonly near Asher, Canadian, Dale, Goodnight, and Yahola soils. Asher soils have a mollic epipedon and have a fine-silty control section. Canadian soils have a mollic epipedon. Dale soils have a fine-silty control section and have a mollic epipedon more than 20 inches thick. Goodnight soils have a sandy control section and are not stratified. Yahola soils are calcareous throughout the control section.

Typical pedon of Hawley fine sandy loam in an area of Hawley fine sandy loam, rarely flooded, undulating, in cropland about 3 miles west and 2 1/2 miles south of Yale, Oklahoma; 1,000 feet west and 100 feet north of the southeast corner of sec. 35, T. 19 N., R. 5 E.

Ap—0 to 7 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A1—7 to 10 inches; brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) moist; moderate fine granular structure; slightly hard, very friable; neutral; clear smooth boundary.

B2—10 to 32 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine granular structure; slightly hard, very friable; neutral; clear smooth boundary.

C—32 to 60 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; massive; slightly hard, very friable; thin strata of loam to fine sand; few films of calcium carbonate; calcareous; moderately alkaline.

The solum is 20 to 50 inches thick. Depth to secondary carbonates ranges from 20 to 60 inches.

The A horizon typically has hue of 7.5YR, value of 4 or 5, and chroma of 3 or 4. Reaction is neutral or mildly alkaline.

The B2 horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. Reaction ranges from neutral to moderately alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 5 to 7, and chroma of 4 to 6. Texture is fine sandy loam with thin strata of loam to fine sand. Reaction ranges from neutral to moderately alkaline.

Huska Series

Huska soils are deep, moderately well drained, and very slowly permeable. They are on broad, very slightly concave, very gently sloping to gently sloping ridgetops on uplands. These soils formed in material weathered from interbedded sandstones and shales of Permian age. The soils of the Huska series are fine, mixed, thermic Mollic Natrustalfs. Slope ranges from 1 to 5 percent.

Huska soils are commonly near Agra, Coyle, Doolin, Grainola, Seminole, Renfrow, and Zaneis soils. Agra soils do not have a natric horizon. Coyle soils have a fine-loamy control section and siliceous mineralogy and do not have a natric horizon. Doolin soils have a mollic epipedon. Grainola soils are less than 40 inches deep and do not have a natric horizon. Seminole soils have a mollic epipedon and do not have an abrupt textural change between the A horizon and the B2t horizon. Renfrow soils do not have a natric horizon or an abrupt textural change between the A horizon and the B2t horizon. Zaneis soils have a fine-loamy control section and do not have a natric horizon.

Typical pedon of Huska silt loam in an area of Huska silt loam, 1 to 3 percent slopes, on the Oklahoma State University Golf Driving Range in Stillwater; 2,200 feet west and 500 feet south of the northeast corner of sec. 10, T. 19 N., R. 2 E.

A1—0 to 9 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 3/4) moist; weak fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

B21t—9 to 18 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate coarse columnar structure; extremely hard, very firm; thick nearly continuous clay films on peds; ped faces are dark reddish brown (5YR 3/2); few small black concretions; 22 percent exchangeable sodium; neutral; clear smooth boundary.

B22t—18 to 25 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; few fine faint strong brown mottles; moderate medium subangular blocky structure; extremely hard, very firm; thin nearly continuous clay films on peds; 39 percent exchangeable sodium; few calcium carbonate concretions; moderately alkaline; clear smooth boundary.

B23t—25 to 34 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak medium blocky structure; extremely hard, very firm; thin nearly continuous clay films on peds; many fine irregular threads of salts; few medium crystals of gypsum; 53 percent exchangeable sodium; mildly alkaline; clear smooth boundary.

B24t—34 to 50 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; weak fine subangular blocky structure; extremely hard, firm; thin patchy clay films on peds; 52 percent exchangeable sodium; moderately alkaline; abrupt smooth boundary.

Cr—50 to 55 inches; light gray (5YR 7/1) sandstone; rippable.

The solum is 40 to 60 inches thick. Exchangeable sodium ranges from 15 to 55 percent in the B2t horizon. Electrical conductivity of the saturation extract ranges from 0 to 2 millimhos per centimeter in the A horizon and from 2 to 6 millimhos per centimeter in the Bt horizon. Depth to secondary carbonates is more than 30 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Texture is fine sandy loam or silt loam. Reaction ranges from medium acid to neutral. When dry, this horizon is both hard and massive in most pedons.

The B21t horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. In some pedons it has mottles in shades of red. Texture is silty clay loam, clay loam, silty clay, or clay. Clay content ranges from 35 to 45 percent. Ped faces have lower value and chroma than the matrix in most pedons. Reaction ranges from neutral to moderately alkaline.

The B22t horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 3 to 6. In some pedons it is mottled in shades of red and brown. Texture is silty clay loam, clay loam, silty clay, or clay. Calcium carbonate concretions and visible threads of salts are present in most pedons.

The B23t horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 4 to 8. In some pedons it is mottled in shades of red and brown. Texture is silty clay loam, clay loam, clay, or silty clay. Soft bodies of calcium carbonate, threads of salts, and dark concretions are present in most pedons.

The B24t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is silty clay loam, clay loam, clay, or silty clay. In some pedons this horizon is calcareous and contains threads and soft bodies of salts.

The Cr horizon consists of reddish or grayish interbedded sandstone and sandy shale and red shale. Most of the rock is weakly consolidated and rippable.

Kirkland Series

Kirkland soils are deep, well drained, and very slowly permeable. They are on broad, linear, nearly level to very gently sloping ridgetops on uplands in the central and western parts of Payne County. These soils formed in clayey alluvium underlain by Permian shales. The soils of the Kirkland series are fine, mixed, thermic Udertic Paleustolls. Slope ranges from 0 to 2 percent.

Kirkland soils are commonly near Bethany, Doolin, Norge, Renfrow, and Seminole soils. Bethany soils do not have an abrupt textural change between the A horizon and the B2t horizon. Doolin soils have a natric horizon. Norge soils have a fine-silty control section. Renfrow soils do not have an abrupt textural change between the A horizon and the B2t horizon and have a mollic epipedon less than 20 inches thick. Seminole soils have a natric horizon and do not have an abrupt textural change between the A horizon and the B2t horizon.

Typical pedon of Kirkland silt loam in an area of Kirkland silt loam, 0 to 2 percent slopes, in cropland about 4 miles north of Perkins, Oklahoma; 700 feet south and 2,200 feet west of the northeast corner of sec. 18, T. 18 N., R. 3 E.

Ap—0 to 9 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; very hard, friable; neutral; abrupt smooth boundary.

B21t—9 to 34 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; extremely hard, very firm; thick nearly continuous clay films on peds; mildly alkaline; gradual smooth boundary.

B22t—34 to 63 inches; brown (7.5YR 5/4) silty clay, brown (7.5YR 4/4) moist; moderate coarse subangular blocky structure; extremely hard, very firm; thin nearly continuous clay films on peds; moderately alkaline; gradual smooth boundary.

B23t—63 to 78 inches; yellowish red (5YR 5/6) silty clay, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; extremely hard, very firm; thin patchy clay films on peds; calcareous; moderately alkaline; gradual smooth boundary.

B3—78 to 90 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; weak coarse subangular blocky structure; extremely hard, very firm; calcareous; moderately alkaline.

The solum is more than 60 inches thick. Depth to secondary carbonates ranges from 30 to 50 inches.

The A horizon typically has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2. Reaction ranges from medium acid to neutral.

The B21t horizon has hue of 5YR to 10YR, value of 4, and chroma of 2 or 3. Texture is silty clay or clay. Reaction is neutral or mildly alkaline.

The B22t horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is silty clay, clay, or silty clay loam.

The B23t horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 6. In some pedons it is mottled in shades of brown or gray. Texture is silty clay, silty clay loam, or clay.

The B3 horizon has hue of 2.5YR to 7.5YR, value of 5, chroma of 4 to 6. In some pedons it is mottled in shades of brown and gray. Texture is clay or silty clay loam.

Konawa Series

Konawa soils are deep, well drained, and moderately permeable. They are on broad, convex, very gently sloping to sloping ridgetops and side slopes on uplands. These soils formed in thick deposits of wind-reworked loamy old alluvial sediment. The soils of the Konawa series are fine-loamy, mixed, thermic Ultic Haplustalfs. Slope ranges from 1 to 8 percent.

Konawa soils are commonly near Dougherty, Eufaula, Navina, Slaughterville, and Teller soils. Dougherty soils have an A horizon that is more than 20 inches thick. Eufaula soils have an A horizon that is more than 20 inches thick and have a sandy control section. Navina soils have a mollic epipedon. Slaughterville soils have a coarse-loamy control section and do not have an argillic horizon. Teller soils have a mollic epipedon.

Typical pedon of Konawa fine sandy loam (fig. 19) in an area of Konawa fine sandy loam, 1 to 3 percent slopes, in a bermudagrass pasture about 8 miles west and 1 mile south of Perkins, Oklahoma; 2,000 feet north and 200 feet west of the southeast corner of sec. 10, T. 17 N., R. 1 E.

A1—0 to 9 inches; brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

A2—9 to 17 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B2t—17 to 53 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; very hard, friable; thin patchy clay films on peds; medium acid; gradual smooth boundary.

B3—53 to 72 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; weak coarse subangular blocky structure; very hard, friable; neutral.

The solum is more than 50 inches thick.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is loamy fine sand or fine sandy loam. Reaction ranges from strongly acid to slightly acid, except where the soil has been limed.

The A2 horizon, where present, has hue of 5YR to 10YR, value of 5 to 7, and chroma of 2 to 4. Texture is loamy fine sand or fine sandy loam. Reaction ranges from strongly acid to slightly acid, except where the soil has been limed.

Figure 19.—Profile of a Konawa soil.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 7, and chroma of 4 to 8. Texture is fine sandy loam or sandy clay loam. Reaction is strongly acid or medium acid.

The B3 horizon has hue of 2.5YR or 5YR, value of 5 to 7, and chroma of 4 to 8. Texture is loamy fine sand or fine sandy loam. Reaction ranges from strongly acid to neutral.

The C horizon, where present, has hue of 2.5YR, value of 5, and chroma of 6. In some pedons it is mottled in shades of brown. Texture is loamy fine sand. Reaction ranges from medium acid to neutral.

Lucien Series

Lucien soils are shallow, well drained, and moderately rapidly permeable. They are on narrow, convex, very gently sloping to sloping ridgetops and side slopes on uplands. These soils formed in material weathered from sandstone. The soils of the Lucien series are loamy, mixed, thermic, shallow Typic Haplustolls. Slope ranges from 1 to 8 percent.

Lucien soils are commonly near Coyle, Darnell, Grainola, Masham, Shidler, Steedman, and Zaneis soils. Coyle soils have a solum more than 20 inches thick and have an argillic horizon. Darnell soils do not have a mollic epipedon and are more acid in reaction. Grainola and Steedman soils have a solum more than 20 inches thick and have a fine control section. Masham soils have a clayey control section. Shidler soils have a lithic contact. Zaneis soils have a solum more than 40 inches thick and have an argillic horizon.

Typical pedon of Lucien fine sandy loam in an area of Coyle-Lucien complex, 2 to 5 percent slopes; 50 feet east and 100 feet north of the southwest corner of sec. 1, T. 20 N., R. 4 E.

Ap—0 to 7 inches; reddish brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B2—7 to 17 inches; reddish brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; abrupt smooth boundary.

Cr—17 to 25 inches; yellowish red (5YR 4/6) sandstone.

The thickness of the solum ranges from 10 to 20 inches and is the same as depth to bedrock. The mollic epipedon is 7 inches or more thick.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Texture is loam or fine sandy loam. Reaction ranges from medium acid to neutral.

The B2 horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 3 to 6. Texture is loam or fine sandy loam. Fragments of sandstone less than 3 inches in diameter make up 0 to 10 percent by volume and fragments greater than 3 inches in diameter make up 0 to 20 percent by volume. Reaction ranges from medium acid to neutral.

The Cr horizon is red, pink, reddish brown, yellowish red, or light reddish brown rippable sandstone.

The Lucien soils in map units 26 and 91 are taxadjuncts to the Lucien series because they have a mollic epipedon slightly thinner than is typical in the series. Also, the Lucien soil in map unit 52 is a taxadjunct to the Lucien series because it has hue of 10YR throughout, which is not typical for the series. Use, management, and behavior are similar to those of the Lucien series.

Masham Series

Masham soils are shallow, well drained, and very slowly permeable. They are on convex, gently sloping to steep ridgetops and side slopes on uplands in the central and western parts of Payne County. These soils formed in material weathered from silty or clayey shales of Permian age. The soils of the Masham series are clayey, mixed, thermic, shallow Typic Ustochrepts. Slope ranges from 5 to 45 percent.

Masham soils are commonly near Grainola and Lucien soils. Grainola soils have a solum more than 20 inches deep and have an argillic horizon. Lucien soils have a mollic epipedon and have a loamy control section.

Typical pedon of Masham silty clay loam in an area of Masham silty clay loam, 5 to 20 percent slopes, in rangeland about 6 miles north and 4 miles east of Stillwater, Oklahoma; 500 feet west and 150 feet south of the northeast corner of sec. 21, T. 20 N., R. 3 E.

A1—0 to 5 inches; reddish brown (2.5YR 4/4) silty clay loam, dark reddish brown (2.5YR 3/4) moist; strong very fine subangular blocky structure; hard, firm; many fine roots; calcareous; moderately alkaline; gradual smooth boundary.

B2—5 to 16 inches; reddish brown (2.5YR 5/4) silty clay, reddish brown (2.5YR 4/4) moist; moderate medium and fine subangular blocky structure; hard, firm; many pressure faces; many fine roots; few round calcium carbonate concretions from 10 to 50 mm in diameter; calcareous; moderately alkaline; diffuse wavy boundary.

Cr—16 to 40 inches; reddish brown (2.5YR 5/4) weathered silty shale, reddish brown (2.5YR 4/4) moist; massive; extremely hard, extremely firm; few fine roots between shale fragments; calcareous; moderately alkaline.

The solum is 10 to 20 inches thick. The soil is moderately alkaline throughout, except that some pedons are noncalcareous in the A horizon. Coarse fragments of limestone, sandstone, hematite, and hard pitted calcium carbonate concretions cover 0 to 35 percent of the surface.

The A horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silty clay loam, clay loam, or silty clay. Round fragments of sandstone, ironstone, and calcium carbonate concretions less than 3 inches in diameter make up 0 to 10 percent by volume.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is silty clay loam or silty clay. Round calcium carbonate concretions less than 3 inches in diameter make up 1 to 5 percent by volume.

The Cr horizon has hue of 2.5YR, value of 3 to 5, and chroma of 4 to 6. In some pedons pockets of gray or olive shale are intermixed in the horizon. The silty shale or clayey shale is weathered, can be dug with a spade when moist, and parts to angular fragments when dry.

McLain Series

McLain soils are deep, moderately well drained, and slowly permeable. They are on narrow, nearly level, high flood plains along major tributaries in the northern part of Payne County. The soils formed in thick deposits of predominantly clayey alluvial sediment. The soils of the McLain series are fine, mixed, thermic Pachic Argiustolls. Slope ranges from 0 to 1 percent.

McLain soils are commonly near Dale soils. Dale soils have a fine-silty control section.

Typical pedon of McLain silt loam in an area of McLain silt loam, rarely flooded, in a bermudagrass pasture about 5 miles east and 1/2 mile north of Glencoe, Oklahoma; 1,800 feet south and 200 feet west of the northeast corner of sec. 2, T. 20 N., R. 4 E.

A1—0 to 18 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; mildly alkaline; clear smooth boundary.

B21t—18 to 29 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable; patchy clay films on peds; neutral; gradual smooth boundary.

B22t—29 to 45 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; very hard, very firm; thin nearly continuous clay films on peds; ped faces are dark reddish brown (5YR 3/3); neutral; gradual smooth boundary.

B23t—45 to 68 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate coarse prismatic structure; very hard, very firm; thin near continuous clay films on peds; moderately alkaline; gradual smooth boundary.

B3—68 to 80 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, very firm; calcareous; moderately alkaline.

The solum is 30 inches to more than 60 inches thick.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2. Reaction is neutral or mildly alkaline.

The B1 horizon, where present, has hue of 5YR or 7.5YR, value of 4, and chroma of 2 or 3. Reaction ranges from neutral to moderately alkaline.

The B21t horizon has hue of 5YR, value of 4 or 5, and chroma of 2 or 3. Texture is silty clay loam or clay loam; this horizon is 35 to 39 percent clay. Reaction ranges from neutral to moderately alkaline.

The B22t horizon has hue of 5YR, value of 5, and chroma of 3. Texture is silty clay loam or silty clay; this horizon is 35 to 50 percent clay. Reaction ranges from neutral to moderately alkaline.

The B23t horizon has hue of 5YR, value of 5, and chroma of 4. Reaction is mildly alkaline or moderately alkaline.

The B3 horizon has hue of 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silty clay loam or clay loam. Reaction is mildly alkaline or moderately alkaline.

Minco Series

Minco soils are deep, well drained, and moderately permeable. They are on broad, convex, very gently sloping to gently sloping ridgetops and side slopes on uplands. These soils formed in thick deposits of loamy eolian sediment. The soils of the Minco series are coarse-silty, mixed, thermic Udic Haplustolls. Slope ranges from 1 to 5 percent.

Minco soils are commonly near Norge, Slaughterville, and Teller soils. Norge soils have a fine-silty control section. Slaughterville soils have a coarse-loamy control section and do not have a mollic epipedon. Teller soils have a fine-loamy control section.

Typical pedon of Minco very fine sandy loam in an area of Minco very fine sandy loam, 1 to 3 percent slopes, in cropland about 1 mile west of Perkins, Oklahoma; 3,400 feet south and 500 feet east of the northwest corner of sec. 2, T. 17 N., R. 2 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A1—7 to 18 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B21—18 to 48 inches; reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

B22—48 to 72 inches; brown (7.5YR 5/4) very fine sandy loam, brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable; moderately alkaline.

The solum is more than 60 inches thick.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid or neutral.

The B2 horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6. Texture is very fine sandy loam or silt loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon, where present, has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 6. Texture is fine sandy loam or very fine sandy loam. Reaction is mildly alkaline or moderately alkaline.

Mulhall Series

Mulhall soils are deep, well drained, and moderately permeable. They are on broad, linear, gently sloping side slopes on uplands. These soils formed in colluvial material weathered mainly from Permian sandstone. The soils of the Mulhall series are fine-loamy, siliceous, thermic Udic Paleustolls. Slope ranges from 3 to 5 percent.

Mulhall soils are commonly near Agra, Coyle, Grainola, Harrah, Norge, Renfrow, Teller, and Zaneis soils. Agra soils have a fine control section. Coyle soils have a solum less than 40 inches thick. Grainola soils do not have a mollic epipedon and have a fine control section. Harrah soils do not have a mollic epipedon. Norge soils have a fine-silty control section. Renfrow soils have a fine control section. Teller soils decrease in clay by more than 20 percent within a depth of 60 inches. Zaneis soils have a solum less than 60 inches thick and are underlain by sandstone bedrock.

Typical pedon of Mulhall loam in an area of Mulhall loam, 3 to 5 percent slopes, in rangeland about 6 miles south and 3 miles west of Stillwater, Oklahoma; 200 feet north and 1,600 feet west of the southeast corner of sec. 17, T. 18 N., R. 2 E.

A1—0 to 13 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

B1—13 to 17 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak medium granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

B21t—17 to 31 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; thin nearly continuous clay films on peds; common fine roots; few rounded sandstone fragments less than 3 inches in diameter; slightly acid; gradual smooth boundary.

B22t—31 to 41 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; common fine distinct strong brown and reddish brown mottles; moderate medium prismatic structure; hard, firm; thin nearly continuous clay films on peds; common fine roots; slightly acid; gradual wavy boundary.

B23t—41 to 70 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; many coarse prominent pinkish gray (5YR 6/2) and light reddish brown (5YR 6/3) mottles; weak coarse prismatic structure; hard, firm; thin patchy clay films on peds; few fine roots; about 10 percent of vertical ped faces coated with clean sand grains; neutral; clear wavy boundary.

IICr—70 to 80 inches; red (10R 5/6) weakly laminated silty shale, red (10R 4/6) moist; calcareous; moderately alkaline.

The solum is more than 60 inches thick.

The A horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 or 3. Reaction ranges from medium acid to mildly alkaline.

The B1 horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 to 4. Texture is loam or clay loam. Reaction is slightly acid or neutral.

The B21t horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 8. In some pedons it has mottles in shades of red and brown. Texture is clay loam or sandy clay loam. Rounded sandstone fragments less than 3 inches in diameter make up 0 to 10 percent by volume. Reaction is slightly acid or neutral.

The B22t horizon has hue of 2.5YR to 7.5YR, value of 5 or 6, and chroma of 4 to 8. It has mottles in shades of red or brown. Texture is clay loam or sandy clay loam. Rounded sandstone fragments less than 3 inches in diameter make up 0 to 10 percent by volume. Reaction ranges from slightly acid to mildly alkaline.

The B23t horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. It has mottles in shades of red, brown, or gray. Texture is clay loam, sandy clay loam, gravelly clay loam, or gravelly sandy clay loam. Dark concretions less than 3 inches in diameter make up 0 to 20 percent by volume. Reaction ranges from neutral to moderately alkaline.

Some pedons have a B24t horizon that is similar in color, texture, and reaction to the B23t horizon.

The IICr horizon is weakly consolidated red silty shale.

Navina Series

Navina soils are deep, well drained, and moderately permeable. They are on broad, linear, nearly level to very gently sloping ridgetops on uplands. These soils formed in thick deposits of old loamy alluvial sediment. The soils of the Navina series are fine-loamy, mixed, thermic Udic Argiustolls. Slope ranges from 0 to 3 percent.

Navina soils are commonly near Bethany, Konawa, and Teller soils. Bethany soils have a fine control section. Konawa soils do not have a mollic epipedon. Teller soils have hue of 5YR or redder in the B2t horizon.

Typical pedon of Navina loam in an area of Navina loam, 0 to 1 percent slopes, in a cultivated field about 9 miles west and 1 mile north of Perkins, Oklahoma; 1,200 feet east and 300 feet north of the southwest corner of sec. 27, T. 18 N., R. 1 E.

Ap—0 to 10 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B1—10 to 14 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; neutral; clear smooth boundary.

B21t—14 to 24 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable; thin nearly continuous clay films on peds; neutral; clear smooth boundary.

B22t—24 to 31 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; moderate medium and coarse subangular blocky structure; hard, firm; thin nearly continuous clay films on peds; neutral; gradual smooth boundary.

B23t—31 to 40 inches; reddish yellow (7.5YR 6/8) fine sandy loam, strong brown (7.5YR 5/8) moist; moderate medium subangular blocky structure; slightly hard, friable; thin nearly continuous clay films on peds; neutral; gradual smooth boundary.

B3—40 to 60 inches; reddish yellow (7.5YR 6/8) fine sandy loam, strong brown (7.5YR 5/8) moist; weak coarse prismatic structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C1—60 to 75 inches; reddish yellow (7.5YR 7/6) loamy fine sand, reddish yellow (7.5YR 6/6) moist; massive; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C2—75 to 80 inches; reddish yellow (7.5YR 6/8) fine sandy loam, strong brown (7.5YR 5/8) moist; massive; slightly hard, friable; mildly alkaline.

The solum is more than 60 inches thick. The mollic epipedon is less than 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from slightly acid to mildly alkaline.

The B1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is loam or clay loam. Reaction ranges from slightly acid to mildly alkaline.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. Texture is loam or clay loam. Reaction ranges from slightly acid to mildly alkaline.

The B22t horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 6. In some pedons it has mottles in shades of brown, yellow, or red. Texture is clay loam or sandy clay loam. Reaction is neutral or mildly alkaline.

The B23t horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. In some pedons it has mottles in shades of brown, yellow, or red. Texture is fine sandy loam or sandy clay loam. Reaction is neutral or mildly alkaline.

The B3 horizon has hue of 5YR to 10YR, value of 5 to 8, and chroma of 4 to 8. In some pedons it has mottles in shades of red, brown, or yellow. Texture is loam, fine sandy loam, or sandy clay loam. Reaction is neutral or mildly alkaline.

The C horizon has hue of 5YR to 10YR, value of 5 to 8, and chroma of 6 to 8. In some pedons it has mottles in shades of red, brown, or yellow. Texture is fine sandy loam or loamy fine sand. Reaction is neutral or mildly alkaline.

Norge Series

Norge soils are deep, well drained, and moderately slowly permeable. They are on broad, convex, very gently sloping to gently sloping ridgetops and side slopes on uplands. These soils formed in thin deposits of old loamy alluvial sediment. The soils of the Norge series are fine-silty, mixed, thermic Udic Paleustolls. Slope ranges from 1 to 5 percent.

Norge soils are commonly near Agra, Bethany, Kirkland, Minco, Mulhall, Renfrow, and Teller soils. Agra, Bethany, Kirkland, and Renfrow soils have a fine control section. In addition, Kirkland soils have an abrupt textural change between the A horizon and the B2t horizon. Minco soils do not have an argillic horizon. Mulhall and Teller soils have a fine-loamy control section. Also, Teller soils decrease in clay content by more than 20 percent within a depth of 60 inches.

Typical pedon of Norge loam, in an area of Norge loam, 1 to 3 percent slopes, in rangeland about 2 miles west of Stillwater, Oklahoma; 1,300 feet west and 500 feet south of the northeast corner of sec. 17, T. 19 N., R. 2 E.

A1—0 to 10 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

B1—10 to 14 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate fine blocky structure; slightly hard, friable; medium acid; clear smooth boundary.

B21t—14 to 24 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate medium blocky structure; hard, firm; thin nearly continuous clay films on peds; neutral; gradual smooth boundary.

B22t—24 to 42 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; moderate medium blocky structure; very hard, very firm; thin nearly continuous clay films on peds; mildly alkaline; gradual smooth boundary.

B23t—42 to 64 inches; reddish brown (2.5YR 5/4) clay loam, reddish brown (2.5YR 4/4) moist; weak medium prismatic structure; very hard, very firm; thin patchy clay films on peds; moderately alkaline; clear smooth boundary.

C—64 to 84 inches; red (2.5YR 5/8) clay loam, red (2.5YR 4/8) moist; massive; hard, firm; moderately alkaline.

The solum is more than 60 inches thick.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam, silt loam, clay loam, or silty clay loam. Reaction ranges from medium acid to neutral.

The B21t and B22t horizons have hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is clay loam or silty clay loam. Reaction ranges from medium acid to mildly alkaline.

The B23t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is clay loam or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon, where present, has hue of 2.5YR or 5YR, value of 5, and chroma of 4 to 8. Texture is silty clay loam or clay loam. Reaction ranges from neutral to moderately alkaline.

Oscar Series

Oscar soils are deep, moderately well drained, and slowly permeable. They are on low, broad, nearly level flood plains along major tributaries in the northern part of Payne County. These soils formed in thick deposits of loamy alluvial sediment. The soils of the Oscar series are fine-silty, mixed, thermic Typic Natrustalfs. Slope ranges from 0 to 1 percent.

Oscar soils are commonly near Ashport, Easpur, Port, and Pulaski soils. Ashport and Port soils have a mollic epipedon and do not have a natric horizon. Easpur soils have a fine-loamy control section and do not have a natric horizon. Pulaski soils have a coarse-loamy control section.

Typical pedon of Oscar silt loam from an area of Port-Oscar complex, occasionally flooded, in cropland about 11 miles west and 2 miles north of Stillwater, Oklahoma; 200 feet west and 400 feet north of the southeast corner of sec. 3, T. 19 N., R. 1 W.

Ap—0 to 9 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; surface crust is light reddish brown (5YR 6/4); weak fine platy structure in upper part, massive in lower part; hard, firm; neutral; clear smooth boundary.

B21t—9 to 17 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; thin patchy clay films on peds; neutral; clear smooth boundary.

B22t—17 to 26 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; weak fine subangular blocky structure; hard, firm; thin patchy clay films on peds; moderately alkaline; gradual smooth boundary.

B23t—26 to 32 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; thin patchy clay films on peds; moderately alkaline; gradual smooth boundary.

B31—32 to 41 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure; hard, firm; moderately alkaline; gradual smooth boundary.

B32—41 to 65 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure; hard, firm; moderately alkaline; gradual smooth boundary.

C—65 to 74 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; calcareous; moderately alkaline.

The solum is more than 20 inches thick. In the B2t and B3 horizons exchangeable sodium ranges from 15 to 80 percent and electrical conductivity of the saturation extract ranges from 4 to 16 millimhos per centimeter.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Reaction ranges from slightly acid to mildly alkaline.

The B21t horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Clay content ranges from 27 to 35 percent. Reaction ranges from neutral to moderately alkaline.

The B22t horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Reaction is mildly alkaline or moderately alkaline.

The B23t horizon has hue of 5YR, value of 4 or 5, and chroma of 2 to 4. Reaction is mildly alkaline or moderately alkaline.

The B3 and C horizons have hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is loam, silt loam, silty clay loam, or clay loam.

Port Series

Port soils are deep, well drained, and moderately permeable. They are on broad, nearly level, low flood plains along major tributaries in the northern part of Payne County. These soils formed in thick deposits of loamy alluvial sediment. The soils of the Port series are fine-silty, mixed, thermic Cumulic Haplustolls. Slope ranges from 0 to 1 percent.

Port soils are commonly near Ashport, Easpur, Oscar, and Pulaski soils. Ashport soils have a mollic epipedon less than 20 inches thick. Easpur soils have a fine-loamy control section. Oscar soils have a natric horizon. Pulaski soils do not have a mollic epipedon and have a coarse-loamy control section.

Typical pedon of Port silt loam in an area of Port silt loam, occasionally flooded, in a cultivated field about 8 miles north and 3 miles east of Stillwater, Oklahoma; 800 feet east and 1,000 feet south of the northwest corner of sec. 8, T. 20 N., R. 2 E.

Ap—0 to 7 inches; reddish brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; weak very fine granular structure; slightly hard, friable; medium acid; clear smooth boundary.

All—7 to 17 inches; dark reddish gray (5YR 4/2) silt loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

A12—17 to 29 inches; dark reddish gray (5YR 4/2) silt loam, dark reddish brown (5YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B21—29 to 44 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

B22—44 to 80 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, friable; few thin strata of reddish brown silty clay loam; calcareous; moderately alkaline.

The solum is more than 40 inches thick. Depth to secondary carbonates is more than 20 inches.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to mildly alkaline.

The B2 horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 2 to 6. Texture is silt loam, loam, silty clay loam, or clay loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon, where present, has hue of 2.5YR or 5YR, value of 5, and chroma of 4 to 6. It is silt loam or loam and is stratified with thin layers of clay loam or silty clay loam. Reaction is moderately alkaline.

Pulaski Series

Pulaski soils are deep, well drained, and moderately rapidly permeable. They are on narrow, nearly level, low flood plains along tributaries throughout Payne County. These soils formed in thick deposits of loamy alluvial sediment. The soils of the Pulaski series are coarse-loamy, mixed, nonacid, thermic Typic Ustifluvents. Slope ranges from 0 to 1 percent.

Pulaski soils are commonly near Ashport, Easpur, Harrah, Oscar, Port, and Tribbey soils. Ashport, Easpur, and Port soils have a mollic epipedon and have a fine-silty control section. Harrah soils have a fine-loamy control section and an argillic horizon. Oscar soils have a natric horizon. Tribbey soils have a water table within 40 inches of the surface during most of the year.

Typical pedon of Pulaski fine sandy loam in an area of Pulaski fine sandy loam, occasionally flooded, in bermudagrass pasture about 5 miles north and 4 miles east of Ripley, Oklahoma; 200 feet south and 100 feet east of the northwest corner of sec. 36, T. 19 N., R. 4 E.

A—0 to 8 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

C1—8 to 20 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; massive; soft, very friable; neutral; gradual smooth boundary.

C2—20 to 80 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; thin strata of reddish brown (2.5YR 4/4) loam, loamy fine sand, and very fine sandy loam; massive; soft, very friable; moderately alkaline.

The 10- to 40-inch control section is noncalcareous.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Reaction ranges from medium acid to neutral.

The C horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam or loam with thin strata of loam to loamy fine sand. Reaction ranges from medium acid to moderately alkaline.

Some pedons have an Ab horizon below a depth of 30 inches. The Ab horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 2 to 6. Texture is loam, silt loam, fine sandy loam, or silty clay loam. Reaction ranges from medium acid to moderately alkaline.

Some pedons have a buried Cb horizon that is similar to the Ab horizon in color and reaction. Texture is loam or fine sandy loam with thin strata of loam to fine sand.

Renfrow Series

Renfrow soils are deep, well drained, and very slowly permeable. They are on broad, convex, very gently sloping to gently sloping ridgetops and side slopes on uplands in the central and western parts of Payne County. These soils formed in material weathered from Permian clayey shale. The soils of the Renfrow series are fine, mixed, thermic, Udertic Paleustolls. Slope ranges from 1 to 5 percent.

Renfrow soils are commonly near Bethany, Coyle, Doolin, Grainola, Huska, Kirkland, Mulhall, Norge, and Zaneis soils. Bethany soils have a mollic epipedon more than 20 inches thick. Coyle soils have a fine-loamy control section and have a solum less than 40 inches thick. Doolin soils have a natric horizon. Grainola soils do not have a mollic epipedon and have a solum less than 40 inches thick. Huska soils do not have a mollic epipedon and have a natric horizon. Kirkland soils have an abrupt textural change between the A horizon and the B2t horizon. Mulhall soils have a fine-loamy control section. Norge soils have a fine-silty control section. Zaneis soils have a fine-loamy control section and have a solum less than 60 inches thick.

Typical pedon of Renfrow silt loam, in an area of Renfrow silt loam, 3 to 5 percent slopes, in rangeland about 2 miles south and 3 miles east of Perkins, Oklahoma; 400 feet east and 200 feet north of the southwest corner of sec. 15, T. 17 N., R. 3 E.

A1—0 to 10 inches; dark reddish gray (5YR 4/2) silt loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B1—10 to 15 inches; reddish brown (5YR 5/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; hard, firm; few patchy clay films on peds; few fine black bodies; slightly acid; gradual smooth boundary.

B21t—15 to 30 inches; reddish brown (5YR 5/4) silty clay, reddish brown (5YR 4/4) moist; moderate fine blocky structure; very hard, very firm; clay films on peds; few fine black concretions; neutral; gradual smooth boundary.

B22t—30 to 42 inches; yellowish red (5YR 5/6) silty clay, yellowish red (5YR 4/6) moist; moderately fine and medium blocky structure; very hard, very firm; clay films on peds; common fine and medium black concretions; neutral; gradual smooth boundary.

B23t—42 to 66 inches; red (2.5YR 4/6) silty clay, dark red (2.5YR 3/6) moist; weak medium blocky structure; very hard, very firm; clay films on peds; few fine black concretions; calcareous; moderately alkaline.

The solum is more than 60 inches thick. Depth to secondary carbonates ranges from 28 to 50 inches.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Texture is loam or silt loam. Reaction ranges from slightly acid to mildly alkaline.

The B1 horizon has hue of 5YR, value of 4 or 5, and chroma of 2 to 4. Texture is clay loam or silty clay loam. Reaction ranges from slightly acid to mildly alkaline.

The B21t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4. Texture is silty clay loam, silty clay, or clay. Reaction ranges from slightly acid to moderately alkaline.

The B22t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silty clay, or clay. In some pedons the lower part of this horizon is calcareous. Reaction ranges from neutral to moderately alkaline.

The B23t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 6 to 8. Texture is clay or silty clay.

In some pedons this horizon is calcareous. Reaction is mildly alkaline or moderately alkaline.

The C horizon, where present, is reddish, calcareous clay. The Cr layer typically is red, weathered, consolidated clayey shale.

The Renfrow soils in map units 47 and 49 are taxadjuncts to the Renfrow series because the mollic epipedon is thinner than is typical for the series. Use, behavior, and management are similar to those of the Renfrow series.

Seminole Series

Seminole soils are deep, moderately well drained, and slowly permeable. They are on broad, slightly concave, nearly level to gently sloping ridgetops and side slopes on uplands in the eastern part of Payne County. These soils formed in materials weathered from interbedded sandstone and shales of Pennsylvanian age. The soils of the Seminole series are fine, mixed, thermic Typic Natrustolls. Slope ranges from 0 to 5 percent.

Seminole soils are commonly near Agra, Chickasha, Huska, and Kirkland soils. Agra and Kirkland soils do not have a natric horizon. Chickasha soils have a fine-loamy control section and do not have a natric horizon. Huska soils do not have a mollic epipedon.

Typical pedon of Seminole loam in an area of Seminole loam, 0 to 2 percent slopes, in rangeland about 6 miles east and 1 mile south of Cushing, Oklahoma; 900 feet west and 100 feet north of the southeast corner of sec. 4, T. 17 N., R. 6 E.

A1—0 to 12 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B1—12 to 15 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—15 to 24 inches; brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; strong medium blocky structure parting to moderate medium and fine subangular blocky; hard, firm; nearly continuous dark brown clay films on peds; mildly alkaline; gradual smooth boundary.

B22t—24 to 32 inches; strong brown (7.5YR 5/6) clay loam, strong brown (7.5YR 4/6) moist; moderate medium and fine subangular blocky structure; hard, firm; thin nearly continuous brown clay films on peds; moderately alkaline; gradual smooth boundary.

B3—32 to 60 inches; coarsely mottled strong brown (7.5YR 5/6), brown (10YR 5/3), dark grayish brown (10YR 4/2), and light gray (10YR 7/2) clay loam; moderate medium and fine subangular blocky structure; thin patchy clay films on peds; moderately alkaline.

The solum is more than 60 inches thick. Exchangeable sodium ranges from 15 to 40 percent in the B2t and B3 horizons.

The A horizon typically has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 7.5YR, value of 4 to 6, and chroma of 2 to 4. Texture is loam or clay loam.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. In some pedons it is mottled in shades of brown or red. Texture is clay or clay loam. Reaction ranges from neutral to moderately alkaline.

The B22t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. In some pedons it is coarsely mottled or has mottles in shades of brown. Texture is clay loam, silty clay loam, or clay. Reaction is mildly alkaline or moderately alkaline.

Some pedons have a B23t horizon. The B23t horizon is similar to the B22t horizon in color, texture, and reaction except that value and chroma are 1 or 2 units higher.

The B3 horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. In some pedons it is coarsely mottled or has mottles in shades of red, brown, yellow, and gray. Texture is clay loam, clay, or silty clay.

Some pedons have a Cr horizon of brownish or grayish sandy shale.

The Seminole soil in map unit 79 is a taxadjunct to the Seminole series because the layer having mollic colors is slightly thinner than is typical for the series. Use, behavior, and management are similar to those of the Seminole series.

Shidler Series

Shidler soils are very shallow and shallow, well drained, and moderately permeable. They are on narrow, convex, very gently sloping to sloping ridgetops and side slopes on uplands in the eastern part of Payne County. These soils formed in material weathered from Pennsylvanian limestone. The soils of the Shidler series are loamy, mixed, thermic Lithic Haplustolls. Slope ranges from 1 to 8 percent.

Shidler soils are commonly near Grainola, Lucien, and Steedman soils. Grainola and Steedman soils are more than 20 inches thick, have an ochric epipedon, and have an argillic horizon. Lucien soils are underlain by soft sandstone.

Typical pedon of Shidler clay loam in an area of Steedman-Lucien-Shidler complex, 1 to 15 percent slopes, in rangeland about 6 miles west and 3 miles north of Yale, Oklahoma; 800 feet east and 50 feet south of the northwest corner of sec. 5, T. 19 N., R. 5 E.

A1—0 to 7 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, friable; neutral; gradual smooth boundary.

B21—7 to 13 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable; coarse limestone fragments less than 3 inches in diameter make up 5 percent by volume; neutral; gradual smooth boundary.

B22—13 to 18 inches; pale brown (10YR 6/3) flaggy clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; coarse limestone fragments more than 3 inches in diameter make up 25 percent by volume and coarse fragments less than 3 inches in diameter make up 10 percent by volume; calcareous moderately alkaline; abrupt irregular boundary.

R—18 to 24 inches; light gray (10YR 7/1) hard fractured limestone; fractures are 25 to 50 mm wide and occur at intervals of about 51 cm; fractures contain soil material similar to horizon above and extend to a depth of 30 cm.

The thickness of the solum ranges from 5 to 20 inches and is the same as depth to bedrock.

The A horizon typically has hue of 5YR to 10YR, value of 3 or 4, and chroma of 1 to 3. Texture is loam or clay loam. Reaction ranges from slightly acid to mildly alkaline.

The B2 horizon has hue of 5YR to 10YR, value of 4 to 7, and chroma of 2 to 4. In some pedons the lower part of the B2 horizon is mottled in shades of brown and yellow. Texture is flaggy silty clay loam, flaggy clay loam, flaggy loam, silty clay loam, clay loam, or loam. Coarse fragments of limestone make up 0 to 35 percent by volume. Coarse fragments less than 3 inches in diameter make up 0 to 10 percent by volume and coarse fragments more than 3 inches in diameter make up 0 to 25 percent by volume. Reaction ranges from neutral to moderately alkaline.

The R layer is grayish, hard limestone that is fractured.

Slaughterville Series

Slaughterville soils are deep, well drained, and moderately rapidly permeable. They are on broad, convex, very gently sloping to moderately steep ridgetops and side slopes on uplands. These soils formed in thick deposits of loamy eolian sediment. The soils of the Slaughterville series are coarse-loamy, mixed, thermic Udic Haplustolls. Slope ranges from 1 to 20 percent.

Slaughterville soils are commonly near Derby, Dougherty, Konawa, Minco, and Teller soils. Derby soils have a sandy control section. Dougherty, Konawa and Teller soils have an argillic horizon and a loamy and fine-loamy control section. Minco soils have a coarse-silty control section.

Typical pedon of Slaughterville fine sandy loam in an area of Slaughterville fine sandy loam, 1 to 3 percent slopes, in an alfalfa field about 5 miles north and 2 miles west of Cushing, Oklahoma; 2,200 feet north and 100 feet east of the southwest corner of sec. 5, T. 18 N., R. 5 E.

A1—0 to 16 inches; brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable; neutral; gradual smooth boundary.

B21—16 to 30 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; moderate fine granular structure; soft, very friable; neutral; gradual smooth boundary.

B22—30 to 44 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine granular structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

B23—44 to 74 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak fine granular structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C—74 to 80 inches; red (2.5YR 5/8) fine sandy loam, red (2.5YR 4/8) moist; massive; slightly hard, friable; mildly alkaline.

The A horizon typically has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Reaction ranges from slightly acid to mildly alkaline.

The B2 horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 8. Reaction ranges from slightly acid to mildly alkaline.

The C horizon has hue of 2.5YR to 7.5YR, value of 5 to 7, and chroma of 4 to 8. Texture is fine sandy loam, loamy fine sand, or loam. Reaction ranges from neutral to moderately alkaline.

Steedman Series

Steedman soils are moderately deep, moderately well drained, and slowly permeable. They are on broad, convex, gently sloping to moderately steep side slopes on uplands in the eastern part of Payne County. These soils formed in material weathered from Pennsylvanian clayey shales. The soils of the Steedman series are fine, montmorillonitic, thermic Vertic Haplustalfs. Slope ranges from 3 to 15 percent.

Steedman soils are commonly near Agra, Lucien, and Shidler soils. Agra soils have a mollic epipedon and have a solum more than 40 inches thick. Lucien and Shidler soils have a solum less than 20 inches thick and have a mollic epipedon.

Typical pedon of Steedman stony clay loam in an area of Steedman-Lucien-Shidler complex, 1 to 15 percent slopes, in rangeland about 6 miles west and 3 miles north of Yale, Oklahoma; 1,500 feet south and 700 feet east of the northwest corner of sec. 5, T. 19 N., R. 5 E.

A1—0 to 7 inches; gray (10YR 5/1) stony clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; flat limestone fragments less than 3 inches in diameter make up 10 percent by volume and flat limestone fragments more than 3 inches in diameter make up 20 percent by volume; mildly alkaline; clear smooth boundary.
B1—7 to 11 inches; grayish brown (10YR 5/2) stony clay loam, dark grayish brown (10YR 4/2) moist; strong medium and coarse granular structure; slightly hard, friable; flat limestone fragments less than 3 inches in diameter make up 10 percent by volume and flat limestone fragments more than 3 inches in diameter make up 10 percent by volume; mildly alkaline; clear smooth boundary.
B2t—11 to 20 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, very firm; few slickenslides; calcareous; moderately alkaline; clear smooth boundary.
B3—20 to 28 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; very hard, very firm; few slickensides; calcium carbonate concretions make up 10 percent by volume; calcareous; moderately alkaline; clear smooth boundary.
Cr—28 to 40 inches; light yellowish brown (10YR 6/4) clayey shale, yellowish brown (10YR 5/4) moist.

The thickness of the solum ranges from 20 to 40 inches and commonly is the same as depth to bedrock.

The A horizon typically has hue of 7.5YR or 10YR, value of 4 or 5 and chroma of 1 to 4. Texture is clay loam or stony clay loam. Content of coarse fragments ranges from 15 to 35 percent by volume. Coarse fragments more than 3 inches in diameter make up 10 to 25 percent by volume and coarse fragments less than 3 inches in diameter make up 5 to 10 percent by volume. Reaction ranges from slightly acid to mildly alkaline.

The B1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is clay loam, stony clay loam, stony silty clay loam, or silty clay loam. Content of coarse fragments ranges from 0 to 35 percent by volume. Coarse fragments more than 3 inches in diameter make up 0 to 25 percent by volume and coarse fragments less than 3 inches in diameter make up 0 to 10 percent by volume. Reaction ranges from slightly acid to mildly alkaline.

The B2t horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 2 to 4. In some pedons it is mottled in shades of brown. Texture is clay or silty clay. Reaction ranges from slightly acid to moderately alkaline.

The B3 horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 2 to 6. In some pedons it is mottled in shades of brown, red, or gray. Texture is silty clay or clay. Fragments of shale less than 3 inches in diameter make up 0 to 10 percent by volume. Reaction ranges from slightly acid to moderately alkaline.

The Cr horizon is brownish clayey shale that can be dug with a spade when moist.

Stephenville Series

Stephenville soils are moderately deep, well drained, and moderately permeable. They are on broad, convex, very gently sloping to sloping ridgetops and side slopes on uplands. These soils formed in material weathered from sandstone. The soils of the Stephenville series are fine-loamy, siliceous, thermic Ultic Haplustalfs. Slopes range from 1 to 8 percent.

Stephenville soils are commonly near Coyle, Darnell, and Harrah soils. Coyle soils have a mollic epipedon. Darnell soils have a solum less than 20 inches thick and do not have an argillic horizon. Harrah soils have a solum more than 40 inches thick.

Typical pedon of Stephenville fine sandy loam in an area of Stephenville-Darnell complex, 1 to 8 percent slopes; 1,100 feet south and 700 feet east of the northwest corner of sec. 28, T. 19 N., R. 1 E.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist, weak fine granular structure; soft, very friable; medium acid; diffuse smooth boundary.
A2—5 to 11 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine granular structure; soft, very friable; medium acid; clear smooth boundary.
B21t—11 to 27 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable; thin patchy clay films on peds; medium acid; gradual smooth boundary.
B22t—27 to 40 inches; red (2.5YR 5/8) sandy clay loam, red (2.5YR 4/6) moist; slightly hard, friable; patchy clay films on peds; medium acid; abrupt wavy boundary.
Cr—40 to 44 inches; light red (2.5YR 6/6) soft sandstone.

The thickness of the solum ranges from 20 to 40 inches and is the same as the depth to bedrock.

The A1 horizon typically has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. Reaction ranges from strongly acid to slightly acid. In some pedons the upper few inches are neutral as a result of liming.

The A2 horizon typically has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. Reaction ranges from strongly acid to slightly acid.

The B21t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is fine sandy loam or sandy clay loam. Reaction is strongly acid or medium acid.

The B22t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is fine sandy loam or sandy clay loam. Reaction is strongly acid or medium acid.

The Cr horizon is reddish soft sandstone.

Teller Series

Teller soils are deep, well drained, and moderately permeable. They are on broad, convex, nearly level to gently sloping ridgetops and side slopes on uplands. These soils formed in thick deposits of old loamy alluvial sediment. The soils of the Teller series are fine-loamy, mixed, thermic Udic Argiustolls. Slope ranges from 0 to 5 percent.

Teller soils are commonly near Dougherty, Eufaula, Konawa, Minco, Mulhall, Navina, Norge, and Slaughterville soils. Dougherty soils do not have a mollic epipedon. Eufaula soils do not have a mollic epipedon and have a sandy control section. Konawa soils have an ochric epipedon. Minco soils have a coarse-silty control section and do not have an argillic horizon. Mulhall soils do not decrease in clay content by more than 20 percent within a depth of 60 inches. Navina soils have hue of 7.5YR or yellower in the B2t horizon. Norge soils have a fine-silty control section and do not decrease in clay content by more than 20 percent within a depth of 60 inches. Slaughterville soils do not have a mollic epipedon or an argillic horizon.

Typical pedon of Teller fine sandy loam in an area of Teller fine sandy loam, 1 to 3 percent slopes, in a cultivated field about 1 mile west and 1 mile north of Perkins, Oklahoma, 2,100 feet north and 80 feet east of the southwest corner of sec. 36, T. 18 N., R. 2 E.

Ap—0 to 6 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

A1—6 to 15 inches; brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; slightly hard, friable; medium acid; gradual smooth boundary.

B1—15 to 20 inches; brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; medium acid; gradual smooth boundary.

B21t—20 to 32 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 3/6) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; thin nearly continuous clay films on peds; medium acid; gradual smooth boundary.

B22t—32 to 42 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm; patchy clay films on peds; medium acid; gradual smooth boundary.

B23t—42 to 60 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; slightly hard, friable; patchy clay films on peds; medium acid; diffuse smooth boundary.

C—60 to 70 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; medium acid.

The solum is more than 50 inches thick.

The A horizon typically has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is fine sandy loam or loam. Reaction is medium acid or slightly acid. In some pedons that have been limed, this horizon is neutral in reaction.

The B1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam or fine sandy loam. Reaction ranges from medium acid to neutral.

The B21t and B22t horizons have hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is sandy clay loam or clay loam. Reaction ranges from medium acid to neutral.

The B23t and B3 horizons have hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. Texture is loam or fine sandy loam. Reaction ranges from medium acid to neutral.

The C horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 6 to 8. Texture is fine sandy loam. Reaction ranges from medium acid to mildly alkaline.

The Teller soil in map unit 59 is a taxadjunct to the Teller series because the mollic epipedon is slightly thinner than is typical for the series. Use, management, and behavior are similar to those of the Teller series.

Tribbey Series

Tribbey soils are deep and somewhat poorly drained. Permeability is moderate or moderately rapid. These soils are on narrow, nearly level, low flood plains along minor tributaries in the southern part of Payne County. A water table is within 40 inches of the surface during most of the year. These soils formed in thin deposits of loamy alluvial sediment. The soils of the Tribbey series are coarse-loamy, mixed, nonacid, thermic Aquic Udifluvents. Slope ranges from 0 to 1 percent.

Tribbey soils are commonly near Pulaski soils. Pulaski soils do not have a water table within 40 inches of the surface.

Typical pedon of Tribbey fine sandy loam (fig. 20) in an area of Tribbey fine sandy loam, frequently flooded, in pasture about 3 1/2 miles east and 3 miles south of

Yale, Oklahoma; 1,750 feet east and 250 feet north of the southwest corner of sec. 35, T. 19 N., R. 6 E.

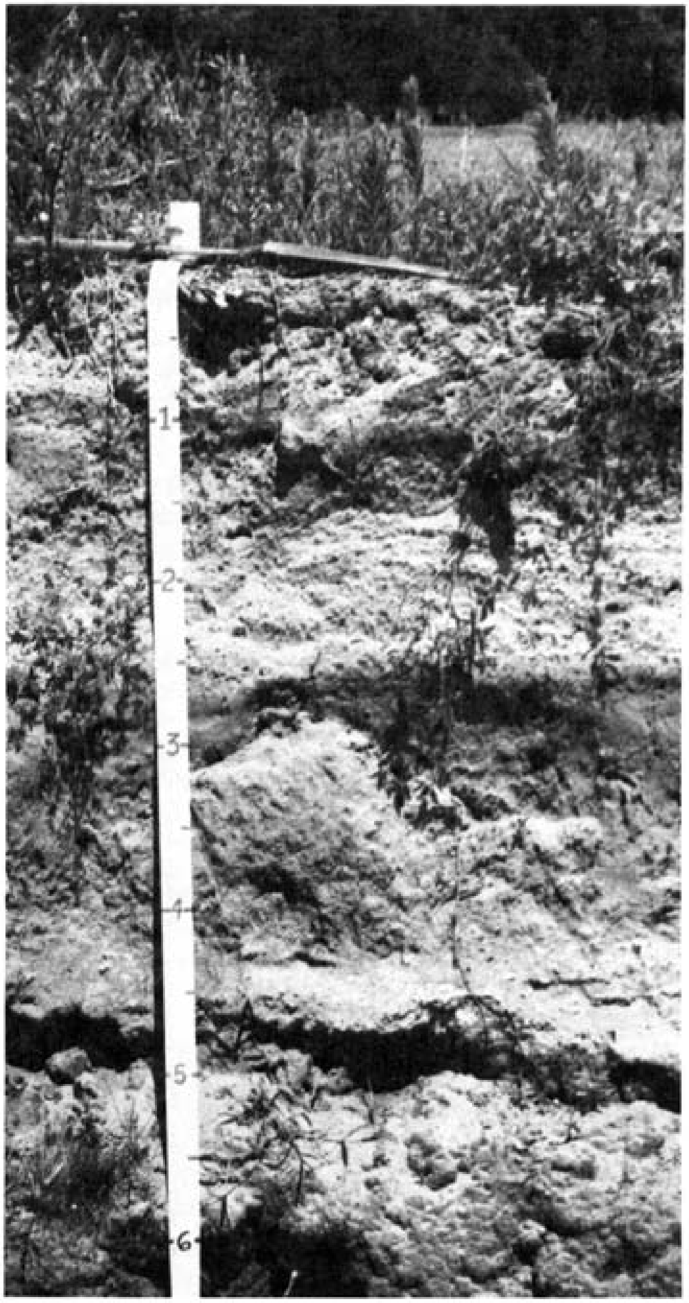


Figure 20.—Profile of Tribbey fine sandy loam.

A1—0 to 6 inches; brown (7.5YR 5/2) fine sandy loam, brown (7.5YR 4/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

C—6 to 40 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable; thin strata of loam, clay loam, and loamy fine sand; moderately alkaline; abrupt smooth boundary.

Ab—40 to 50 inches; brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable; moderately alkaline; clear smooth boundary.

Cb—50 to 60 inches; brown (7.5YR 5/2) fine sandy loam, brown (7.5YR 4/2) moist; massive; soft, very friable; moderately alkaline.

The depth to buried horizons ranges from 30 to 60 inches. The depth to ground water ranges from 20 to 40 inches.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. Reaction ranges from slightly acid to mildly alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6. It is fine sandy loam or fine sandy loam stratified with thin layers of loam, clay loam, and loamy fine sand. Reaction ranges from neutral to moderately alkaline.

The Ab horizon has hue of 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from neutral to moderately alkaline.

The Cb horizon typically has hue of 7.5YR, value of 5, and chroma of 2 or 3. Reaction ranges from neutral to moderately alkaline.

Yahola Series

Yahola soils are deep, well drained, and moderately rapidly permeable. They are on broad, nearly level, low flood plains along the Cimarron River. These soils formed in thick deposits of loamy alluvial sediment. The soils of the Yahola series are coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents. Slope ranges from 0 to 1 percent.

Yahola soils are commonly near Gaddy, Goodnight, Gracemore, Harjo Variant, and Hawley soils. Gaddy soils have a sandy control section. Goodnight soils have a sandy control section and are not calcareous throughout the control section. Gracemore soils have a sandy control section and a water table within 40 inches of the surface during most of the year. Harjo Variant soils have a clayey over sandy or sandy-skeletal control section. Hawley soils are not calcareous throughout the control section and have a cambic horizon.

Typical pedon of Yahola fine sandy loam in an area of Yahola fine sandy loam, occasionally flooded, in a cultivated field about 7 miles west and 1 1/2 miles south of Perkins, Oklahoma; 2,400 feet south and 300 feet east of the northwest corner of sec. 13, T. 17 N., R. 1 E.

Ap—0 to 8 inches; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

C1—8 to 34 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; soft, very friable; thin strata of loamy fine sand; calcareous; moderately alkaline; clear smooth boundary.

C2—34 to 46 inches; light red (2.5YR 6/6) fine sandy loam, red (2.5YR 4/6) moist; massive; soft, very friable; thin strata of loamy fine sand; calcareous; moderately alkaline; clear smooth boundary.

C3—46 to 64 inches; reddish yellow (5YR 7/6) loamy fine sand, yellowish red (5YR 5/6) moist; single grained; loose; thin strata of fine sandy loam and loam; calcareous; moderately alkaline.

Depth to secondary carbonates ranges from 0 to 10 inches.

The A horizon typically has hue of 5YR, value of 4 or 5, and chroma of 4 to 6. Reaction is mildly alkaline or moderately alkaline.

The C1 horizon has hue of 5YR, value of 5 or 6, and chroma of 4 to 6. It is fine sandy loam with thin strata of loamy fine sand, very fine sandy loam, or clay loam.

The C2 horizon has hue of 2.5YR or 5YR, value of 5 to 7, and chroma of 6.

The C3 horizon has hue of 5YR, value of 5 to 7, and chroma of 6.

Zaneis Series

Zaneis soils are deep, well drained, and moderately slowly permeable. They are on broad, convex, very gently sloping to gently sloping ridgetops and side slopes on uplands in the central and western parts of Payne County. These soils formed in materials weathered from interbedded sandstones and shales of Permian age. The soils of the Zaneis series are fine-loamy, mixed, thermic Udic Argiustolls. Slope ranges from 1 to 5 percent.

Zaneis soils are commonly near Coyle, Chickasha, Doolin, Huska, Lucien, Mulhall, and Renfrow soils. Coyle soils have a solum less than 40 inches thick. Chickasha soils have hue of 7.5YR or yellower in the B2t horizon. Doolin soils have a natric horizon and an abrupt textural change between the A horizon and the B2t horizon. Huska soils have an ochric epipedon and a natric horizon. Lucien soils have a solum less than 20 inches thick. Mulhall soils have a solum more than 60 inches thick, and their argillic horizon does not decrease in clay content by as much as 20 percent from the maximum within 60 inches of the surface. Renfrow soils have a fine control section.

Typical pedon of Zaneis loam in an area of Zaneis loam, 1 to 3 percent slopes, in pasture about 1 mile west and 2 miles south of Glenco, Oklahoma; 725 feet west and 125 feet south of the northeast corner of sec. 26, T. 20 N., R. 3 E.

Ap—0 to 6 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

A1—6 to 11 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—11 to 14 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable; few patchy clay films on peds; neutral; clear smooth boundary.

B22t—14 to 29 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm; thin nearly continuous clay films on peds; slightly acid; gradual smooth boundary.

B23t—29 to 40 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; common fine distinct strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; hard, firm; thin nearly continuous clay films on peds; neutral; gradual wavy boundary.

B24t—40 to 47 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; hard, firm; few patchy clay films on peds; neutral; clear wavy boundary.

Cr—47 to 50 inches; red (2.5YR 4/6) weathered sandstone.

The thickness of the solum ranges from 40 to 60 inches and is the same as depth to bedrock.

The A horizon typically has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Texture is fine sandy loam or loam. Reaction ranges from medium acid to neutral.

The B21t horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam or clay loam. Reaction ranges from medium acid to neutral.

The B22t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is clay loam or sandy clay loam. Reaction ranges from medium acid to neutral.

The B23t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. In some pedons it has mottles in shades of brown. Texture is clay loam or sandy clay loam. Reaction ranges from slightly acid to mildly alkaline.

The B24t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is fine sandy loam, sandy clay loam, or clay loam. Coarse fragments of sandstone less than 3 inches in diameter make up 0 to 5 percent by volume. Reaction is slightly acid to mildly alkaline.

The Cr horizon is reddish soft sandstone or sandstone interbedded with reddish sandy shale.

The Zaneis soils in map units 71 and 76 are taxadjuncts to the Zaneis series because they have a mollic surface layer slightly thinner than is typical in the series. Use, behavior, and management are similar to those of the Zaneis soils.

Formation of the Soils

Soil is the product of five major factors: parent material, climate, plants and animals (especially plants), relief, and time. If a given factor, vegetation for example, differs from one area to another, the soils that form in the two areas will differ.

Parent Material

The unconsolidated material that changes into soil influences the rate at which the soil forms; its chemical, physical, and mineral composition; and its color.

Soils on the uplands of Payne County formed in material weathered from sandstone, clay, shale, and limestone. Coyle, Lucien, and Stephenville soils formed in material weathered from sandstone. Agra, Grainola, and Masham soils formed in material weathered from shale. Shidler soils formed in material weathered from limestone. Mulhall soils formed in colluvial sediment weathered from sandstone that caps many of the ridgetops in Payne County.

Alluvial deposits are extensive along the Cimarron River and its many tributaries throughout the county. The kind of sediment deposited and the kinds of soil that form in it depend largely on the source of sediment and the velocity of the floodwater. Ashport and Easpur soils formed in loamy sediment deposited by overflowing streams. Gaddy and Yahola soils formed in sandy and loamy sediment deposited by fast-moving water near the Cimarron River.

Eolian sediment and wind-reworked alluvial sediment are common on the north side of the Cimarron River. Derby and Goodnight soils formed in sandy eolian sediment that had been deposited mostly as large dunes. Dougherty and Eufaula soils formed in wind-reworked alluvial sediment.

Climate

Payne county has a temperate subhumid climate. The climate is fairly uniform throughout the county, and differences between soils cannot be attributed to differences in the present climate. Moisture and temperature have been sufficient to promote the formation of distinct layers in many of the soils. Leaching within the soils is slow because precipitation is limited.

Plant and Animal Life

Plants, burrowing animals, insects, and micro-organisms directly influence the formation of soils. Grasses and trees have different effects on the losses and gains of organic matter and plant nutrients and on the structure and porosity of soils. Agra and Bethany soils developed under prairie and have a dark brown surface layer and a high content of organic matter. Konawa and Stephenville soils developed under oak forest and have a brown surface layer and a low content of organic matter.

Relief

Relief influences the formation of soils through its effect on water movement, erosion, soil temperature, and plant cover. In Payne County, relief is determined largely by the resistance of the underlying rock to weathering, the activity of the Cimarron River and its major tributaries, and geological erosion. About 10 percent of Payne County is nearly level soils on flood plains, and 90 percent is nearly level to steep soils on uplands.

Renfrow and Masham soils formed in similar shale parent material. Their development, however, was controlled to a large extent by relief. The Renfrow soils are less sloping than Masham soils, and they are deeper as well.

Time

As a factor in soil formation, time cannot be measured strictly in years. The length of time needed for development of genetic horizons depends on the intensity of the soil-forming factors and the rate of losses, gains, transfers, or transformations that form the soil horizons. Soils that have no definite genetic horizons are called "young" or "immature." "Mature," or "older," soils have approached equilibrium with their environment and have well defined horizons.

The soils in Payne County range from young to old. Kirkland and Bethany soils are examples of old soils on uplands. Zaneis and Teller soils are younger, but they have well expressed horizons. Lucien and Masham soils are considered young. They have had sufficient time to develop well expressed horizons, but because they are sloping, geological erosion takes away the soil material almost as fast as it forms. Gaddy and Yahola soils are young. Having formed in recently deposited sediment on flood plains, they show little horizon development.

Processes of Soil Formation

Several processes are involved in the formation of soils in Payne County: accumulation of organic matter, leaching of calcium carbonates and bases, reduction and transfer of iron, and formation and translocation of silicate clay minerals. The results of these processes are not evident to the same degree in all soils.

Most of the older soils in the county have three major horizons. Some of the properties in which the major horizons differ are color, texture, structure, consistency, reaction, content of organic matter, and thickness. Subdivisions of the major horizons are based on minor differences.

Geology

By Kenneth S. Johnson, Oklahoma Geological Survey, University of Oklahoma.

The surface geology of Payne County is fairly simple (fig. 21). Outcropping rock formations consist of Pennsylvanian and Permian shales, sandstones, and thin limestones that were deposited near the shores of shallow seas that once covered much of western Oklahoma *(3, 4).* In many parts of the county these sedimentary rocks are mantled by unconsolidated alluvium laid down by ancient or modern rivers and streams. The outcropping strata overlie other sedimentary rocks that are important sources of petroleum in the county.

The subsurface sedimentary rock units are about 3,500 feet thick in the eastern part of Payne County and about 7,500 feet thick in the western part. These strata rest upon a "basement" of granite that extends downward some 20 to 25 miles. The sedimentary rocks were deposited in great shallow seas that bordered the famous deep basins of central Oklahoma (the Anadarko Basin to the southwest and the Arkoma Basin to the southeast). These seas inundated the Payne County

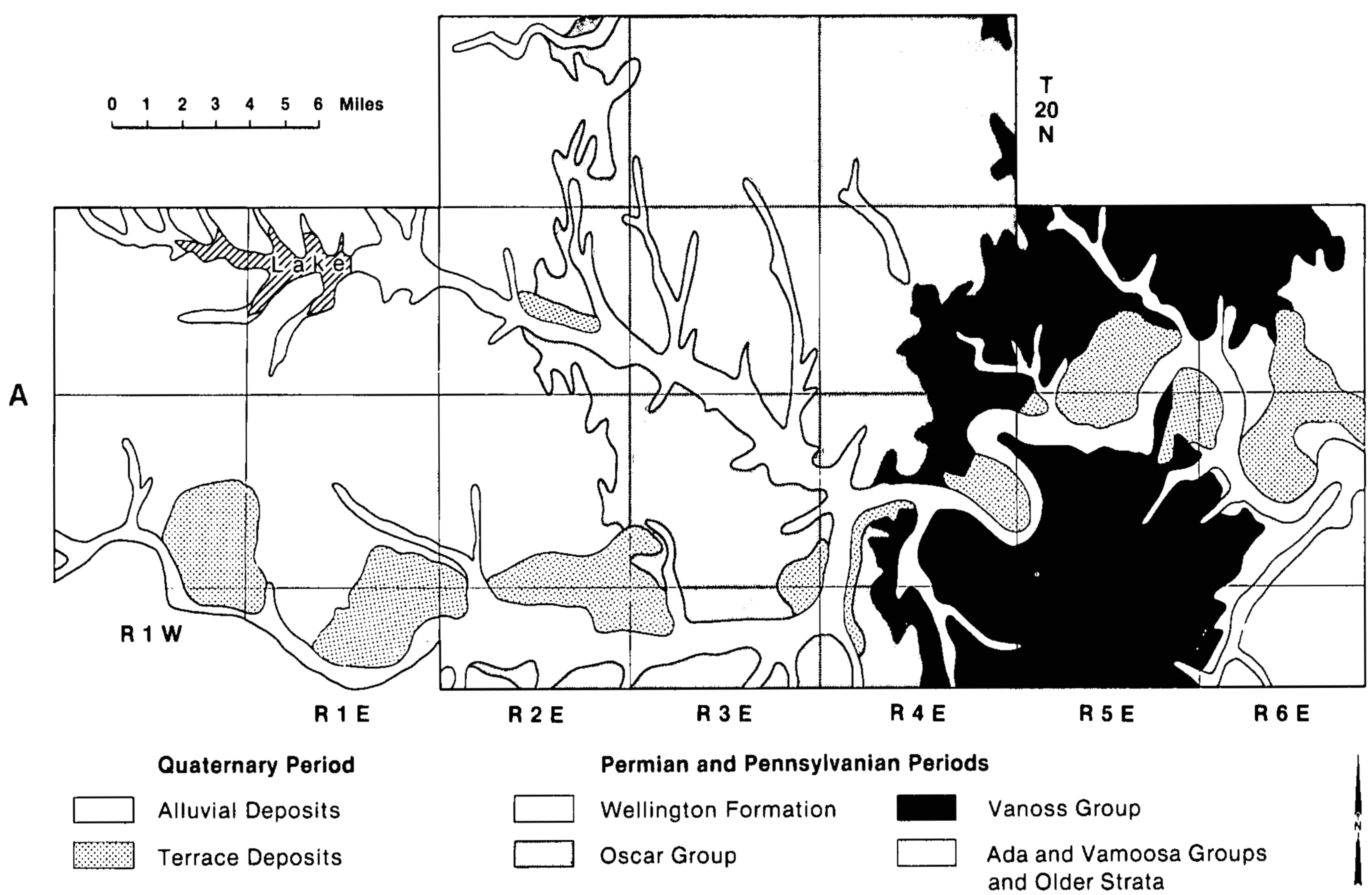


Figure 21.—General geology of Payne County.

area intermittently from the Cambrian Period (about 525 million years ago) until the early part of the Permian Period (about 260 million years ago). Payne County is considered part of the stable platform of north-central Oklahoma, and the various rock formations that underlie the county dip gently to the west.

It was during the Late Pennsylvanian and Early Permian Periods (about 280 to 260 million years ago) that the outcropping rocks of Payne County were laid down. Sands, silts, and clays were eroded from low areas in eastern Oklahoma and adjacent parts of Arkansas. These materials were transported generally to the west and northwest by streams and rivers that then flowed towards a large inland sea that covered most of western Oklahoma. Payne County was close to the shoreline of this ancient sea, and thus it was the site for deposition of interbedded shales, siltstones, sandstones, and thin limestone in alternating river, delta, tidal-flat, and shallow-sea environments.

Outcropping rocks typically are red or reddish-brown in color, particularly in the central and western part of the county, whereas mixtures of red and gray colors are common in the east. The red color results from the presence of iron oxides in the form of oxidized minerals, such as hematite, distributed uniformly throughout the rock. Iron is also present in the gray and other nonred rocks, but not in the oxidized state. Soils that developed from the reddish-colored rocks tend to retain the hematite stain of the parent material, thus explaining the red color of many of the soils in Payne County.

The oldest rocks exposed in Payne County crop out along the eastern border, and these are overlain by successively younger Pennsylvanian and Permian strata to the west. Outcropping strata dip gently to the west at an angle of less than 1 percent (fig. 22).

Inasmuch as the soils in most areas formed in material weathered from exposed rock, the character of these rock formations and the soils that develop from them are closely related. Thus a description of the rock units in the county helps to explain the character and distribution of soils in the county.

The oldest rock exposed in Payne County is the Vamoosa Formation of Late Pennsylvanian age. The Vamoosa Formation consists of shale with lenticular sandstone, but only the uppermost 30 feet of the formation is exposed on the north bank of the Cimarron River where it leaves the county. The exposed area is only about 10 to 20 acres, not enough to enable characterization of the soils that develop from the Vamoosa Formation.

Overlying the Vamoosa Formation is the Ada Group, also of Late Pennsylvanian age. The Ada Group consists chiefly of gray and red-brown shale with some interbedded sandstone and thin limestone. The average thickness of the Ada Group is about 300 feet. Outcrops of the Ada Group are mantled by one of four general soil map units: Agra-Coyle, Chickasha-Seminole, Steedman-Lucien-Grainola, or Stephenville-Darnell. The various soils mantling the Ada Group typically are very gently sloping but range from nearly level to steep; all of these soils are moderately well drained to well drained, loamy soils.

The Vanoss Group overlies the Ada Group. The age of the Vanoss Group is uncertain; it is either Late Pennsylvanian or Early Permian age. The Vanoss Group consists mainly of gray and red-brown shale and contains some lenses of sandstone and thin beds of limestone. Its thickness is commonly about 525 feet. Soils over the Vanoss Group are mainly in the Agra-Coyle and Steedman-Lucien-Grainola general soil map units, although some are mantled by the Renfrow-Coyle-Grainola map unit. These soils typically are very gently sloping to moderately steep, moderately well drained to well drained, and loamy.

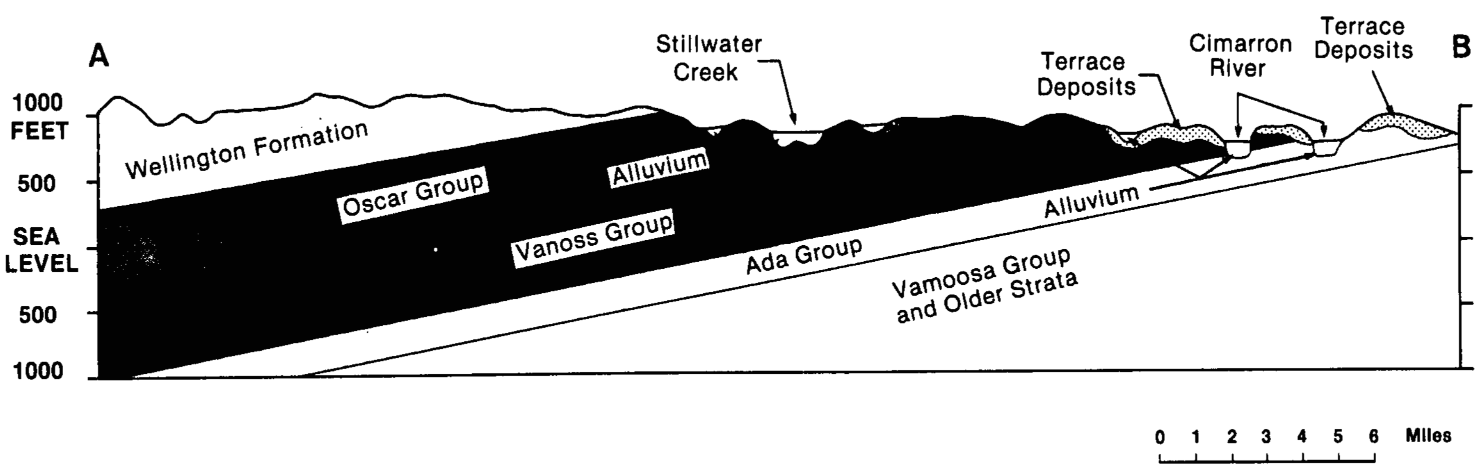


Figure 22.—Geologic cross section of Payne County (line A-B on figure 22).

Overlying the Vanoss Group is the Oscar Group, which also is considered to be either Late Pennsylvanian or Early Permian in age. The Oscar Group is about 600 feet thick and consists mainly of red shale with some interbedded sandstone and thin beds of limestone. The Oscar Group is mantled mainly by the Renfrow-Coyle-Grainola and Stephenville-Darnell general soil map units, and to a much lesser extent by the Renfrow-Kirkland map unit. Soils in these map units typically are nearly level to steep, well drained, and loamy.

Above the Oscar Group is the Wellington Formation of Early Permian age. Approximately 800 feet of Wellington strata crops out in the western third of the county. The Wellington Formation consists mainly of red shale with some sandstone beds and thin layers of limestone nodules. Soils that mantle the Wellington Formation are in the Renfrow-Coyle-Grainola, Grainola-Masham-Lucien, and Stephenville-Darnell general soil map units. They are very gently sloping to steep, well drained, loamy soils.

Quaternary alluvium and terrace deposits in Payne County generally are 10 to 120 feet thick and consist mainly of sand, silt, clay, and some gravel. These sediments were eroded from Permian and Late Pennsylvanian rocks within and to the west of the county, and also from any other rock units exposed west and northwest of the county within the Cimarron River drainage basin. Quaternary sediments were deposited within the past million years or so, mainly as flood plain or alluvial deposits along major rivers and streams. In addition, some of the sand and silt were wind deposited.

Terrace deposits, which consist of older alluvium left behind after a river shifts position or cuts more deeply into underlying material are higher than, and generally adjacent to, the present-day flood plains. Terraces are either broad and nearly level or hummocky and undulating. The terraces are mainly north of the Cimarron River flood plain, but smaller areas are also found north and south of Stillwater Creek. These terrace deposits typically are mantled by the Norge-Teller-Konawa and Konawa-Dougherty-Derby general soil map units. The soils are mostly loamy or sandy, and well drained to somewhat excessively drained. They formed in unconsolidated old alluvial and eolian sediments.

Alluvial deposits in stream channels or flood plains of contemporary rivers and streams are mantled by the Yahola-Gaddy-Hawley general soil map unit along the main stem of the Cimarron River and by the Pulaski-Easpur-Ashport unit along tributary streams.

The mineral and water resources of Payne County are important to the overall development and progress of the county *(5)*. Petroleum production is by far the most important mineral activity; production in the county in 1981 amounted to about 2.5 million barrels of crude oil and about 4.9 billion cubic feet of natural gas, thus ranking Payne County near the middle of the petroleum-producing counties in Oklahoma. Sand and gravel have been mined from a number of sites in the alluvium and terrace deposits of the county, and the thin beds of limestone and sandstone have been quarried at several sites for road-building material. Also, a number of small deposits of copper-bearing minerals are known, but none are being worked. Abundant quantities of good-quality ground water are present in some of the major Quaternary alluvial and terrace deposits and in the Vamoosa-Ada aquifer in the eastern quarter of the county. Small quantities of good-quality ground water are also locally available from some of the thin sandstone beds elsewhere in the county.

References

(1) American Association of State Highway (and Transportation) Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. l0, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Bingham, R. H., and D. L. Bergman. 1980. Reconnaissance of the water resources of the Enid Quadrangle, north-central Oklahoma. Oklahoma Geol. Surv. Hydrol. Atlas 7.

(4) Bingham, R. H., and R. L. Moore. 1975. Reconnaissance of the water resources of the Oklahoma City Quadrangle, central Oklahoma. Oklahoma Geol. Surv. Hydrol. Atlas 4.

(5) Shelton, J. W.—in press Geology and mineral resources of Payne County, Oklahoma. Oklahoma Geol. Surv. Bull 137.

(6) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962.)

(7) United States Department of Agriculture. 1984. Procedures for collecting soil samples and methods of analysis for soil survey. Soil Surv. Invest. Rep. 1, 68 pp., illus.

(8) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. Soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 40-inch profile or to a limiting layer is expressed as—

	Inches
Low	0 to 4
Moderate	4 to 6
High	more than 6

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). The volume of soft soil decreases excessively under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, such as fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium is in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The movement of water into the soil is rapid.

Fertility, natural. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant that is not a grass or a sedge.

Fragile (in tables). The soil is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green-manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

A2 horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O or A horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lamellae. Thin bands or fibers of translocated clay that constitute illuvial, and in many cases argillic, horizons in sandy upland soils.

Large stones (in tables). Rock fragments that are 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The terms for organic matter content are defined as follows—

	Percent
Low	0 to 0.5
Medium	0.5 to 1.0
High	1.0 to 3.0

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Pitting (in tables). Pits are caused by melting ground ice. They form on the soil after plant cover is removed.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). In these areas, surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Rippable bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). There is a shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). The soil mass is susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, thickness of the line can be one fragment or more. It generally overlies material that weathered in place, and it is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). An excessive amount of toxic substances in the soil, such as sodium or sulfur, severely hinders the establishment of vegetation or severely restricts plant growth.

Trace elements. Chemical elements, such as zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). There is a risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors that are assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of course grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. This contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.